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INTELLECTUAL PROPERTY RIGHTS AND RENEWABLE ENERGY TECHNOLOGY TRANSFER IN CHINA

*Kiel Downey**

INTRODUCTION

The extent to which the People's Republic of China (China) develops and implements renewable energy¹ technology has a significant effect on global climate change. In 2007, China surpassed the United States to become the country that emits more carbon dioxide per year than any other country in the world,² and China's emissions have reached double-digit annual growth in the period since then.³ While China has the potential to increase global emissions significantly, it also has the potential to mitigate global emissions by developing and implementing renewable energy technology that can mitigate its share of global emissions. According to data from the Pew Charitable Trusts, China ranked either number one or number two in total clean energy investment among the G-20 countries in 2009, 2010, and 2011,⁴ and renewable

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¹ The International Energy Agency defines renewable energy as "energy that is derived from natural processes (e.g. sunlight and wind) that are replenished at a higher rate than they are consumed. Solar, wind, geothermal, hydro, and biomass are common sources of renewable energy." *Topic: Renewables*, INTERNATIONAL ENERGY AGENCY, <http://www.iea.org/to pics/renewables> (last visited July 26, 2012).

² U.S. Energy Info. Admin., *International Energy Statistics - Total Carbon Dioxide Emissions from the Consumption of Energy (Million Metric Tons)*, U.S. DEPT. OF ENERGY, <http://www.eia.gov/cfapps/ipdbproject/iedind ex3.cfm?tid=90&pid=44&aid=8&cid=regions&syid=1980&eyid=2010&unit =MMTCD> (last visited July 26, 2012).

³ *See id.* The author's calculations are based on data from the U.S. Energy Information Administration.

⁴ G-20 investments in clean energy have made up the majority of global investments in clean energy since at least 2004. *Who's Winning the Clean Energy Race?: 2011 Edition*, THE PEW CHARITABLE TRUSTS, 15 (2012), <http://www.pewtrusts.org/uploadedFiles/wwwpewtrustsorg/Reports/>

energy made up the vast majority of China's clean energy investment portfolio over that period.⁵ As of 2011, China had more total installed clean energy capacity than any other country in the world.⁶

One way in which China can develop a strong renewable energy sector is by acquiring and adapting renewable energy technology from other countries. The United Nations Framework Convention on Climate Change⁷ (the Convention) lists the transfer of clean energy technology among measures that can "control, reduce, or prevent" greenhouse gas emissions,⁸ and many of the Parties to the Convention who are leading the way in clean energy investment have come to recognize renewable energy as an important part of clean energy. In recent years, some of the largest investors in clean energy have made forms of renewable energy the vast majority of their investment portfolios.⁹

Clean_Energy/Clean%20Energy%20Race%20Report%202012.pdf [hereinafter THE PEW CHARITABLE TRUSTS 2011 Edition]; *Who's Winning the Clean Energy Race?*, THE PEW CHARITABLE TRUSTS, 17 (2010), http://www.pewtrusts.org/uploadedFiles/wwwpewtrustsorg/Reports/Global_warming/G20%20Report.pdf?n=5939 [hereinafter THE PEW CHARITABLE TRUSTS 2010 Edition].

⁵ See THE PEW CHARITABLE TRUSTS 2011 Edition, *supra* note 4, at 14; THE PEW CHARITABLE TRUSTS 2010 Edition, *supra* note 4, at 15.

⁶ THE PEW CHARITABLE TRUSTS 2011 Edition, *supra* note 4, at 29.

⁷ U.N. Framework Convention on Climate Change, May 9, 1982, 1771 U.N.T.S. 107, 165, available at <http://unfccc.int/resource/docs/convkp/conveng.pdf>.

⁸ *Id.*

⁹ See THE PEW CHARITABLE TRUSTS 2011 Edition, *supra* note 4, at 14; THE PEW CHARITABLE TRUSTS 2010 Edition, *supra* note 4, at 15; U.N. Framework Convention on Climate Change, *supra* note 7, at 23. All the G-20 countries for which the Pew reports rank clean energy investment are also Parties to the Convention. See *Status of Ratification of the Convention*, U.N. FRAMEWORK CONVENTION ON CLIMATE CHANGE, http://unfccc.int/essential_background/convention/status_of_ratification/items/2631.php (last visited Sept. 29, 2012); *List of Annex I Parties to the Convention*, U.N. FRAMEWORK CONVENTION ON CLIMATE CHANGE, http://unfccc.int/parties_and_observers/parties/annex_i/items/2774.php (last visited July 16, 2012); *List of Non-Annex I Parties to the Convention*, U.N. FRAMEWORK CONVENTION ON CLIMATE CHANGE, http://unfccc.int/parties_and_observers/parties/non_annex_i/items/2833.php (last visited July 16, 2012).

The Convention obligates its Parties to “promote and cooperate in” the transfer of energy technology¹⁰ and obligates the “developed country Parties and other developed Parties included in Annex II” of the Convention to facilitate technology transfer to other Parties,¹¹ which include China.¹² Actors from both China and other Parties to the Convention, however, have argued that concerns over intellectual property rights (IPR) are a significant barrier to the transfer of clean energy technology to China, although for different reasons. For example, the U.S. government has argued that widespread intellectual property (IP) theft and unreliable IPR enforcement in China are significant barriers to technology transfer because investors fear counterfeiting and piracy of their IP. A 2008 International Trade Administration (ITA) report on clean energy technology exports to China states that “[t]he latest U.S. trade losses due to counterfeiting and piracy in China remain unacceptably high,”¹³ and cites IPR as a challenge to the development of clean energy technology business in China.¹⁴ Actors from China, on the other hand, have argued that industrialized countries are excessively protective of their IP, which makes their technology too expensive for China to acquire. For example, Wang Weiwan, head of the Clean Development Mechanism program at the China Renewable Energy Industries Association, said in a 2009 interview, “[i]f [we] buy [developed countries’] equipment, right now it is quite expensive. This kind of high cost, developing countries just cannot take it.”¹⁵

¹⁰ U.N. Framework Convention on Climate Change, *supra* note 7, at 5.

¹¹ *Id.* at 8.

¹² *See id.* at 8, 24. The Convention obligates Parties listed in Annex II of the Convention to facilitate technology transfer to other Parties. *Status of Ratification of the Convention*, *supra* note 9. China is a Party to the Convention, but is not an Annex II Party.

¹³ Energy and Security Group, Int’l Trade Admin., *Clean Energy: An Exporter’s Guide to China*, U.S. DEP’T OF COMMERCE, 39 (2008), <http://www.trade.gov/media/publications/pdf/china-clean-energy2008.pdf>.

¹⁴ *Id.* at 6.

¹⁵ Shi dinghuan: fada guojia ying dapo jianpai jishu zhishichanquan jing (石定寰：发达国家应打破减排技术知识产权禁锢) [Shi Dinghuan: Developed Countries Should Break the Confines of Intellectual Property Rights over Emissions Reduction Technology], SINA.COM (China), Dec. 15, 2009, <http://finance.sina.com.cn/world/gjjj/20091215/21237107945.shtml>.

In this article, I examine whether or not concerns over IPR actually have been a significant barrier to the transfer of renewable energy technology to China. I treat technology transfer as a form of investment, based on calculations of expected risk and return, and examine relevant risk and return factors. In examining expected risk, I look at changes in China's IP laws, changes in China's enforcement of IPR, and the ability of the Chinese renewable energy market to turn non-Chinese IP into marketable products. In examining expected return, I look at the potential for growth in China's renewable energy market, pricing in the market, and incentives for Chinese and non-Chinese firms to partner. I then examine empirical patenting data and anecdotal evidence and conclude that concerns over IPR are not a significant barrier to renewable energy technology transfer to China.

I. TECHNOLOGY AND TECHNOLOGY TRANSFER IN A BROAD SENSE

A. TECHNOLOGY AND ITS RELATIONSHIP TO INTELLECTUAL PROPERTY

In order to discuss technology transfer, we need to understand how "technology" and the "transfer" of that technology are defined in renewable energy. A narrow understanding of "technology" could include only the machinery involved in the process of producing energy. This article adopts a broader notion of technology, as described by Grübler.¹⁶ Grübler's concept of technology includes intangible, knowledge-based assets, such as the knowledge required to produce that machinery, as well as the knowledge required to use the machinery effectively.¹⁷

This characterization of technology explains the link between renewable energy technology and IP. For example, in generating wind power, power companies need not only physical assets like rotors and generators, but also intangible assets, such as the knowledge of how to maintain, repair, and improve upon those physical assets. They need not only data collection systems, but also an understanding of how to effectively interpret and analyze the data they collect. There must also be an effective grid in place to pass to

¹⁶ See ARNULF GRÜBLER, TECHNOLOGY AND GLOBAL CHANGE (1998).

¹⁷ See *id.* at 20.

consumers the energy that those wind turbines produce, and that grid requires its own set of physical and knowledge-based assets.

B. TECHNOLOGY TRANSFER AS INVESTMENT

The transfer of technology is fundamentally a form of investment, based on calculations of expected risk and return. There is no centralized international mechanism for coordinating technology transfer. Rather, technology transfer occurs organically among various public and private actors through channels such as international trade, joint research efforts, licensing, and the cross-border activities of multinational corporations, all of which require an investment of time and resources. In discussing foreign direct investment, Salacuse says that “[i]nvestors will commit funds to a project when in their judgment the project will yield a satisfactory return at an acceptable level of risk,”¹⁸ and any actor considering transferring its renewable energy technology to China will consider the expected risk and return in that particular market before making a decision.

In examining risk, this article looks at the risk that IP in renewable energy technology from industrialized countries will be stolen, reverse-engineered, or unsuccessfully protected in China’s legal system. The article examines some of the major steps that China has taken since the 1990s to improve its protections for IPR, including legal reforms and developments in IPR enforcement, as well as the capacity of actors in China’s renewable energy sector to turn IP acquired from non-Chinese sources into marketable products.

In examining return, this article looks at economic factors that non-Chinese firms take into account when assessing expected return. The article examines prospects for growth and policy support in China’s renewable energy sector, pricing in the renewable energy market, and incentives for non-Chinese firms to partner with Chinese firms in order to show that IPR are not a significant factor in calculations of expected return.

¹⁸ Jeswald Salacuse, *Direct Foreign Investment and the Law in Developing Countries*, 15 ICSID REV. FOREIGN INVESTMENT L.J. 382, 386 (2000).

II. RISK FACTORS

Criticism of China's protection of non-Chinese IPR reflects a variety of opinions on the issue. For example, in June 2009, then-U.S. Representative Mark Kirk said that "the Chinese essentially were seeking 'the stealing of all intellectual property' related to energy efficiency and climate change."¹⁹ The Office of the United States Trade Representative (USTR) has put China on the Priority Watch List of its Special 301 Report every year since 2006,²⁰ and the 2009 Special 301 Report notes that "China's IPR enforcement regime remains largely ineffective and non-deterrent."²¹ The same report, however, notes that "when the Chinese government chooses to exercise its political will to deal with an IPR problem, it can yield results."²² In subsequent Special 301 Reports, USTR has continued to note both ongoing concerns and areas of improvement in China's protection of IPR.²³

¹⁹ Shaun Tandon, *US Draws Line with China on Climate Technology*, AGENCE FRANCE-PRESSE (June 22, 2009), <http://www.google.com/hostednews/afp/article/ALeqM5iJxowxXuScWkFyiTNDYPIHwgkKWw>.

²⁰ OFFICE OF THE U.S. TRADE REPRESENTATIVE, EXEC. OFFICE OF THE PRESIDENT, 2012 SPECIAL 301 REPORT 26 (2012), <http://www.ustr.gov/sites/default/files/2012%20Special%20301%20Report.pdf>; OFFICE OF THE U.S. TRADE REPRESENTATIVE, EXEC. OFFICE OF THE PRESIDENT, 2011 SPECIAL 301 REPORT 19 (2011), http://www.ustr.gov/webfm_send/2841; OFFICE OF THE U.S. TRADE REPRESENTATIVE, EXEC. OFFICE OF THE PRESIDENT, 2010 SPECIAL 301 REPORT 19 (2010), http://www.ustr.gov/webfm_send/1906; OFFICE OF THE U.S. TRADE REPRESENTATIVE, EXEC. OFFICE OF THE PRESIDENT, 2009 SPECIAL 301 REPORT 13 (2009), <http://www.ustr.gov/sites/default/files/Full%20Version%20of%20the%202009%20SPECIAL%20301%20REPORT.pdf>; OFFICE OF THE U.S. TRADE REPRESENTATIVE, EXEC. OFFICE OF THE PRESIDENT, 2008 SPECIAL 301 REPORT 19 (2008), http://www.ustr.gov/sites/default/files/asset_upload_file553_14869.pdf; OFFICE OF THE U.S. TRADE REPRESENTATIVE, EXEC. OFFICE OF THE PRESIDENT, 2007 SPECIAL 301 REPORT 18 (2007), http://www.ustr.gov/sites/default/files/asset_upload_file230_11122.pdf; OFFICE OF THE U.S. TRADE REPRESENTATIVE, EXEC. OFFICE OF THE PRESIDENT, 2006 SPECIAL 301 REPORT 16 (2006), http://www.ustr.gov/archive/assets/Document_Library/Reports_Publications/2006/2006_Special_301_Review/asset_upload_file473_9336.pdf.

²¹ OFFICE OF THE U.S. TRADE REPRESENTATIVE, 2009 SPECIAL 301 REPORT, *supra* note 20, at 13.

²² *Id.*

²³ OFFICE OF THE U.S. TRADE REPRESENTATIVE, 2012 SPECIAL 301 REPORT, *supra* note 20, at 26–35; OFFICE OF THE U.S. TRADE

Since the late twentieth century, China has made two major sets of reforms to its IPR laws to offer better protection for IPR. First, China made significant reforms to its IPR laws in the 1990s and early 2000s as it prepared to join the World Trade Organization (WTO) and bring its IPR regime in line with international standards. Second, China is now developing enough of its own energy technology that it has a homegrown incentive to increase the protection of energy technology IPR in its market, and it has made another set of significant reforms to its IPR laws since the latter half of the 2000s. Together, these two sets of reforms have laid the groundwork for more effective protection of IPR in China.

Enforcement has also become more predictable over this period. Improvements to the letter of the law are not sufficient to ensure greater protection of IPR, and predictability of enforcement is a critical factor in assessing risk. Data from IP litigation in China show that enforcement has been reasonably predictable since at least the early 2000s.

In addition, China's renewable energy sector as a whole has not developed the capability to absorb any given form of pirated IP, reducing the risk that actors in China will steal or reverse-engineer foreign renewable energy IP. Renewable energy technology is complex and interdependent, and many Chinese firms do not have the complementary technology necessary to turn individual renewable energy IP into marketable products and services.

A. REFORMS PRIOR TO WTO ACCESSION

In the 1990s and early 2000s, China made an important set of reforms to its IPR laws in preparation to sign the WTO agreements. The WTO agreements included the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS),²⁴ and China would have to bring its domestic IPR legislation up to minimum

REPRESENTATIVE, 2011 SPECIAL 301 REPORT, *supra* note 20, at 19–25; OFFICE OF THE U.S. TRADE REPRESENTATIVE, 2010 SPECIAL 301 REPORT, *supra* note 20, at 19–23.

²⁴ Agreement on Trade-Related Aspects of Intellectual Property Rights, Apr. 15, 1994, Marrakesh Agreement Establishing the World Trade Organization, Annex 1C, 1869 U.N.T.S. 299, 33 I.L.M. 1197 [hereinafter TRIPS].

international standards in order to meet its obligations under TRIPS upon accession to the WTO in 2001.²⁵

1. THE CONTRACT LAW

No Chinese laws specifically address the protection of IP in renewable energy technology, but in 1999, two years before China signed TRIPS, the National People's Congress (NPC)—China's national legislature—adopted the Contract Law of the People's Republic of China (Contract Law).²⁶ The Contract Law contains a chapter that focuses specifically on contracts for technology,²⁷ and that chapter contains a section that focuses specifically on contracts for technology transfer.²⁸

The Contract Law mitigates the risk associated with technology transfer by creating a formal framework in which IP can be transferred. For example, it defines the types of IP that can be transferred through a contract,²⁹ it specifies that such contracts must be in writing,³⁰ and it defines the legal obligations of both the transferor³¹ and the recipient³² in a technology transfer agreement. The Contract Law also obligates the recipient of transferred technology to maintain the confidentiality of trade secrets.³³

²⁵ TRIPS binds its Parties to a broad set of standards for domestic IPR legislation. The Preamble to TRIPS sets forth this principle. It states that the parties to the Agreement recognize the “need for new rules and disciplines concerning... the provision of adequate standards and principles concerning the availability, scope and use of trade-related intellectual property rights... [and] the provision of effective and appropriate means for the enforcement of trade-related intellectual property rights, taking into account differences in national legal systems.” *Id.* at Preamble, 320.

²⁶ *Zhonghua renmin gongheguo hetong fa* (中华人民共和国合同法) [Contract Law of the P.R.C.] (promulgated by the Standing Comm. Nat'l People's Cong., Mar. 15, 1999; effective Oct 1, 1999) (China) [hereinafter Contract Law], available at http://www.npc.gov.cn/englishnpc/Law/2007-12/11/content_1383564.htm.

²⁷ *Id.* at ch. 18.

²⁸ *Id.*

²⁹ *Id.* at ch. 18, art. 342.

³⁰ *Id.*

³¹ *Id.* at ch. 18, art. 345.

³² *Id.* at ch. 18, art. 346.

³³ *Id.* at ch. 18, art. 348.

However, the Contract Law does not reduce all forms of risk to non-Chinese owners of IP. For example, Article 353 appears to increase risk to transferors of technology, because it makes the transferor liable when the recipient exploits the patent or technical secret under the terms of the contract in a way that “infringes upon the legitimate rights and interests of others.”³⁴ This provision is broadly worded, and transferors must be careful about what technology they transfer and to whom they transfer it. According to the language of this provision, however, the transferor only incurs liability when the recipient uses the transferred technology “as contracted” and “infringes on the lawful interests” of others.³⁵ Thus, at the very least, this provision gives the transferor the power to draft a contract in a way that minimizes the risk to the transferor.

Article 329 of the Contract Law also appears to present some risk to non-Chinese transferors of technology. Article 329 deems a contract that “illegally monopolizes technology”³⁶ or “impedes technological advancement” invalid,³⁷ and the 2005 Supreme People’s Court Interpretation Regarding Several Issues in the Application of Law for the Trial of Technology Contract Dispute Cases³⁸ (Technology Contracts Interpretation) clarifies these provisions. The Technology Contracts Interpretation states that a contract that prohibits research and development (R&D) or improvements upon licensed technology “illegally monopolize[s] technology [or] impairs technological advancement.”³⁹ As this interpretation makes it easier under the law for Chinese firms that license foreign technology to design marginal improvements and compete with their foreign licensors, it represents an increased risk to foreign transferors of technology. This risk is likely mitigated by the relatively low absorptive capacity of China’s renewable energy industry, as discussed in Part II, Section D, below.

³⁴ *Id.* at ch. 18, art. 353.

³⁵ *Id.* (emphasis added).

³⁶ *Id.* at ch. 18, art. 329.

³⁷ *Id.*

³⁸ Zuigao renmin fayuan guanyu shenli jishu hetong jiufen anjian shiyong falü ruogan wenti de jieshi (最高人民法院关于审理技术合同纠纷案件适用法律若干问题的解释) [Supreme People’s Court interpretation of the applicable law, a number of issues on the trial of the technology contract disputes] (Sup. People’s Ct., November 30, 2004) (China).

³⁹ *Id.* at art. 10 (citing Contract Law, *supra* note 26, at art. 329).

2. THE PATENT LAW

In addition to the Contract Law, the Standing Committee of the NPC amended the Patent Law of the People's Republic of China (Patent Law) in 2000,⁴⁰ in preparation for compliance with TRIPS.⁴¹ As the NPC Standing Committee amended the Patent Law again in 2008,⁴² during China's second major set of legal reforms, this article examines the Patent Law in Part II, Section B, below.

3. TRIPS

In renewable energy technology, the most relevant type of IPR protection is the patent, as it covers technological products and processes. Also, TRIPS provides additional clarity and protection for foreign patent holders. Article 27 of TRIPS requires all parties to the Agreement to make patents available "for any inventions, whether products or processes, in all fields of technology, provided that they are new, involve an inventive step and are capable of industrial application."⁴³ Article 27 gives equal protection to foreign patent applicants by providing that "patents shall be available and patent rights enjoyable without discrimination as to the place of invention, the field of technology and whether products are imported or locally produced."⁴⁴

In addition, the WTO has actually enforced China's obligations under TRIPS. There have been no WTO dispute settlement cases directly involving renewable energy technology in China, but a WTO

⁴⁰ Zhonghua renmin gongheguo zhuanlifa (中华人民共和国专利法) [Patent Law of the P.R.C.] (promulgated by the Standing Comm. People's Cong., Mar. 12, 1984, effective Apr. 1, 1985, amended Sept. 4, 1992; amended Aug. 25, 2000, amended Dec. 27, 2008) (China) [hereinafter Patent Law], available at http://www.npc.gov.cn/englishnpc/Law/200712/13/content_1383992.htm.

⁴¹ J. Benjamin Bai et al., *What Does the Third Amendment to China's Patent Law Mean to You?*, JONES DAY, 1 (2009), <http://www.jonesday.com/files/Publication/4bec1582-391d-497a-af19bb314ae94433/Presentation/PublicationAttachment/ff879450-6699-4f2a-93fe-c33eb7d604cc/What%20Does%20Third.pdf>.

⁴² Patent Law, *supra* note 40, at ch.1, art. 1.

⁴³ TRIPS, *supra* note 24, at art. 2.

⁴⁴ *Id.*

Dispute Settlement Body panel found in 2009 that the Copyright Law of the People's Republic of China⁴⁵ (Copyright Law) and certain measures of Chinese customs violated China's commitments under TRIPS.⁴⁶ The panel did not uphold all the claims against China,⁴⁷ but the case proved that China's IPR laws could be successfully challenged under the WTO framework.

B. DOMESTIC INNOVATION AND REFORMS IN THE LATTER HALF OF THE 2000s

The Chinese government and Communist Party have taken steps since the mid-2000s to encourage the development of IP—including renewable energy—in China's economy, and in the process they have increased protections under the law for foreign IP within China's borders. Some knowledge-based sectors of China's economy have experienced significant growth in recent years, and China has dedicated significant resources to Chinese innovators. For example, the number of patent holders in emerging market economies grew by 33% from 1998 to 2008, but almost all of that growth occurred in China.⁴⁸ Chinese patent holders held almost 92% of all locally owned patents in emerging market economies in 2008.⁴⁹ From 2004 to 2008, funding for science and technology activities in China increased by 111%.⁵⁰ Over the same period, expenditure on

⁴⁵ Zhonghua renmin gongheguo zhuzuoquan fa (中华人民共和国著作权法) [Copyright Law of the P.R.C.] (promulgated by the Standing Comm. People's Cong., Sept. 7, 1990; effective June 1, 1991; amended Oct. 27, 2001) (China), available at http://www.npc.gov.cn/englishnpc/Law/2007-12/12/content_1383888.htm.

⁴⁶ See Panel Report, *China—Measures Affecting the Protection and Enforcement of Intellectual Property Rights*, 134, WT/DS362/R (Jan. 26, 2009).

⁴⁷ See *id.*; see also Michael Geist, *Why the U.S. Lost Its WTO IP Complaint against China Badly*, MICHAEL GEIST BLOG (Jan. 27, 2009), <http://www.michaelgeist.ca/content/view/3645/125>.

⁴⁸ Copenhagen Econ. A/S & The IPR Co. ApS, *Are IPR a Barrier to the Transfer of Climate Change Technology?*, COPENHAGEN ECON. 5 (2009), http://trade.ec.europa.eu/doclib/docs/2009/february/tradoc_142371.pdf.

⁴⁹ *Id.*

⁵⁰ National Bureau of Statistics of China, *China Statistical Yearbook 2009*, 820, available at <http://www.stats.gov.cn/tjsj/ndsj/2009/indexeh.htm>.

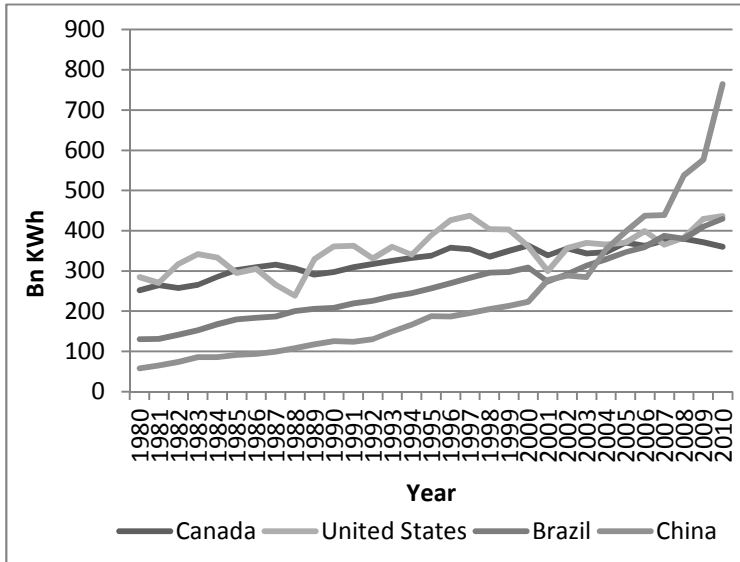
R&D grew by 135% and increased as a share of GDP from 1.23% to 1.54%.⁵¹

China's renewable energy sector is one of the knowledge-based sectors that has experienced significant development since the mid-2000s, in terms of both its output and its IP. For example, Figure 1 shows the net electricity generated from renewable sources from 1980 to 2010 by the four countries that generate more than any other country: Canada, the United States, Brazil, and China.⁵² At the beginning of this period, China lagged behind the other three, but it surpassed them all in 2005 and maintained its leading position in each subsequent year for which data is available.

⁵¹ *Id.*

⁵² Figure 1 is based on data from the U.S. Energy Information Administration. At the time of this writing, the U.S. Energy Information Administration did not provide data for years beyond 2010. See U.S. Energy Info. Admin., *Total Renewable Electricity Net Generation (Billion Kilowatthours)*, U.S. DEPT. OF ENERGY, <http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=6&pid=29&aid=12&cid=BR,CA,CH,US,&syid=1980&eyid=2010&unit=BKWH> (last visited July 25, 2012) [hereinafter U.S. EIA, *Total Renewable Electricity*].

Figure 1 **Net Generation of Electricity from Renewable Sources, 1980-2010**



Source: Based on data from the U.S. Energy Information Administration

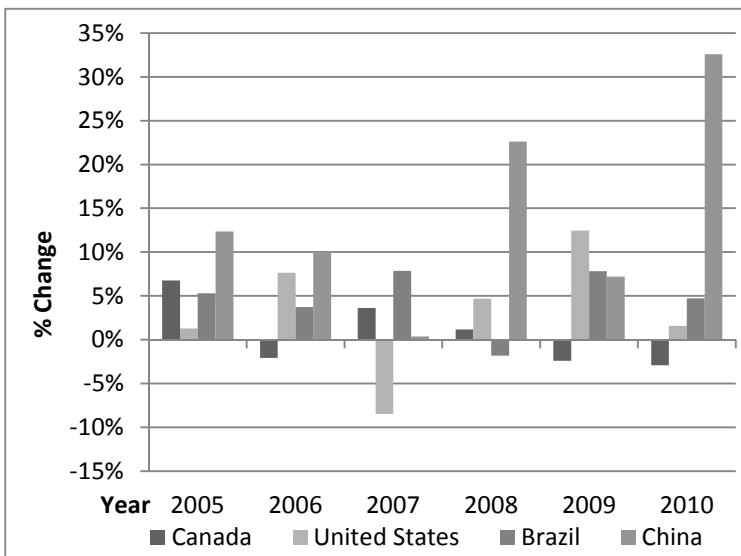
Figure 2 takes the period in which China held the number one position and converts the data into annual percent changes.⁵³ China's growth in generation was higher than each of Canada, the United States, and Brazil in four out of those six years, and China's generation climbed to 32.59% growth in 2010, its highest growth over that period.⁵⁴ The International Energy Agency (IEA) predicts that the capacity of China's renewable energy sector will continue to grow. The Reference Scenario of the IEA's World Energy Outlook 2007 projects that, from 2005 to 2030, China's hydropower capacity

⁵³ *Id.* The data in Figure 2 is based on the data in Figure 1 over the period from 2005 to 2010. Percent change calculations are the author's. The U.S. Energy Information Administration does not provide data for years beyond 2010.

⁵⁴ *Id.*

will increase by 153% and its wind power capacity by 2,208%.⁵⁵ The World Energy Outlook 2010 projects that, from 2008 to 2035, China will account for approximately 20% of the global net increase in renewable energy demand.⁵⁶

Figure 2 **Annual Change in Net Generation of Electricity from Renewable Sources, 2005-2010**



Source: Based on data from the U.S. Energy Information Administration

China's renewable energy sector has grown not only larger, but also more technologically sophisticated. According to data from Lee et al., by 2009, China held significant shares of worldwide patents in various renewable energy technologies, including over 10% of

⁵⁵ *World Energy Outlook 2007: China and India Insights*, INTERNATIONAL ENERGY AGENCY, 355 (2007), http://iea.org/publications/fr/eepublications/publication/weo_2007.pdf [hereinafter INTERNATIONAL ENERGY AGENCY, *World Outlook*].

⁵⁶ *Id.* at 99.

worldwide patents in wind power, biomass, and concentrated solar power (CSP).⁵⁷ When those numbers are adjusted to account for the geographic origin of the parent companies, Chinese companies still held approximately 5% to 8% of global patents in those technologies.⁵⁸

As IP has become an increasingly important part of China's economy, new language in official policy documents and laws in the latter half of the 2000s reflects an increased high-level emphasis on encouraging knowledge-based sectors of China's economy, including renewable energy, as discussed in the next section. As China increases official support for Chinese innovators, it also reduces the expected risk for foreign innovators who are considering transferring their IP into the Chinese market. Under the national treatment principle in TRIPS, China has an obligation to treat the IP of other TRIPS signatories in a manner "no less favourable" than that in which it treats the IP of Chinese innovators,⁵⁹ giving China an obligation to extend improved protections for IP to foreign owners of IP who operate within China's borders.

1. HIGH-LEVEL POLICY DOCUMENTS

China's Eleventh Five-Year Plan⁶⁰ lists the following among China's national policy goals: "strengthening of independent

⁵⁷ Bernice Lee et al., *Who Owns Our Low-Carbon Future?: Intellectual Property and Energy Technologies*, CHATHAM HOUSE, 15 (2009), http://www.chathamhouse.org/sites/default/files/public/Research/Energy,%20Environment%20and%20Development/r0909_lowcarbonfuture.pdf.

⁵⁸ *Id.*

⁵⁹ TRIPS, *supra* note 24, at art. 3.

⁶⁰ China's "Five-Year Plans" are sets of national-level guidelines for economic and social development that cover five-year increments and are based on official recommendations from the Central Committee of the Communist Party of China, a high-level decision-making authority within the Communist Party. The National People's Congress, China's national legislature, approves outlines of each Five-Year Plan for official public release, and each of these outlines is commonly referred to as a "Five-Year Plan." The Eleventh Five-Year Plan covers the period from 2006 to 2010. Outline of the Eleventh Five-Year Plan for National Economic and Social Development, *Zhonghua renmin gongheguo guomin jingji he shehui fazhan di shiyi ge wu nian guihua gangyao* (中华人民共和国国民经济和社会发展

innovative capability, increasing research and development expenditure as a share of GDP to 2% [by 2010], and forming a body of superior industries that have independent intellectual property, well-known brands, and stronger international competitiveness.”⁶¹ China’s 2008 Outline of the National Intellectual Property Strategy⁶² also discusses the importance of IP in depth. For example, the opening paragraph states that the Outline is “formulated for the purpose of improving China’s capacity to create, utilize, protect and administer intellectual property, making China an innovative country and attaining the goal of building a moderately prosperous society in all respects.”⁶³

2. THE ANTI-MONOPOLY LAW

In 2007, the Standing Committee of the NPC adopted China’s first antitrust law, the Anti-Monopoly Law of the People’s Republic of China (Anti-Monopoly Law).⁶⁴ Patents grant monopoly rights to patent holders over a fixed period of time, and of all the laws

第十一个五年规划纲要) [National development and social development in the Eleventh Five-Year Plan Outline] (promulgated by National People’s Cong., Mar. 16, 2006) Xinhua News Agency (China) [hereinafter Eleventh Five-Year Plan], *available at* http://news.xinhuanet.com/misc/2006-03/16/content_4309517.htm.

⁶¹ *Id.* at ch. 1, § 3.

⁶² The Outline of the National Intellectual Property Strategy was issued by the State Council, the highest executive authority in the government of the People’s Republic of China. Guojia zhishichanquan zhanlue gangyao (国家知识产权战略纲要) [Outline of the National Intellectual Property Strategy] (promulgated by the State Council of the People’s Republic of China, June 5, 2008), *available at* http://english.gov.cn/2008-06/21/content_1023471.htm.

⁶³ *Id.*

⁶⁴ Zhonghua renmin gongheguo fanlongduan fa (中华人民共和国反垄断法) [Anti-Monopoly Law of the P.R.C.] (promulgated by the Standing Comm. Nat’l People’s Cong., Aug. 30, 2007, effective Aug. 1, 2008) (China) [hereinafter Anti-Monopoly Law], *available at* http://www.npc.gov.cn/englishnpc/Law/2009-02/20/content_1471587.htm; *see* Peter J. Wang & Yizhe Zhang, *New Chinese Anti-Monopoly Law*, JONES DAY (2007), <http://www.jonesday.com/files/Publication/eb6dcb2a-624d-4242-b791-cc8faa3a1e52/Presentation/PublicationAttachment/4836e746-cc52-49cd-b96c-d764ae9bea1a/New%20Chinese%20Anti-Monopoly.pdf>.

discussed in this paper, the Anti-Monopoly Law poses the greatest risk to foreign firms who transfer their IP into the Chinese market.

Wang and Zhang provide a thorough explanation of the various provisions in the Anti-Monopoly Law that could increase risk to foreign firms transferring IP into the Chinese market.⁶⁵ One example relates to the autonomy that licensors have to prohibit licensees from patenting improvements to the licensors' technology.⁶⁶ Article 13(4) prohibits "restricting the purchase of new technology or new facilities or the development of new technology or new products."⁶⁷ Wang & Zhang note that contracts that prohibit research and development or improvements upon licensed technology can be interpreted as "illegal monopoly of technology" under the Technology Contracts Interpretation,⁶⁸ which could lead them to be interpreted as "impair[ing] technological advancement."⁶⁹ If read together, the Anti-Monopoly Law and the Technology Contracts Interpretation may make it difficult for foreign licensors of technology to prevent Chinese licensees from patenting improvements to foreign technology.

Another important provision, echoing the argument from developing countries that IPR protection makes technology too expensive to acquire, is Article 17(1), which prohibits "a business operator with a dominant market position" from "selling commodities at unfairly high prices"⁷⁰ The law does not define "dominant market position," but it is reasonable to assume that a

⁶⁵ Wang & Zhang, *supra* note 64, at 3–4.

⁶⁶ *Id.* at 3.

⁶⁷ Anti-Monopoly Law, *supra* note 64, at ch. 2, art. 13(4).

⁶⁸ Wang & Zhang, *supra* note 64, at 3 (quoting Zuigao renmin fayuan guanyu shenli jishu hetong jiufen anjian shiyong falü ruogan wenti de jieshi (最高人民法院审理技术合同纠纷案件适用法律若干问题的解释) [Interpretation of the Supreme People's Court concerning Some Issues on Application of Law for the Trial of Cases on Disputes over Technology Contracts] (Sup. People's Ct., Dec. 16, 2004) (China) art. 10).

⁶⁹ Zuigao renmin fayuan guanyu shenli jishu hetong jiufen anjian shiyong falü ruogan wenti de jieshi (最高人民法院审理技术合同纠纷案件适用法律若干问题的解释) [Interpretation of the Supreme People's Court concerning Some Issues on Application of Law for the Trial of Cases on Disputes over Technology Contracts] (Sup. People's Ct., Dec. 16, 2004) (China) art. 10.

⁷⁰ Anti-Monopoly Law, *supra* note 64, at ch. 3, art. 17(1).

Chinese court would be more likely to determine that a company with a greater market share occupies a dominant market position than a company with a smaller market share, and that certain foreign firms hold significant market share in China's renewable energy market. For example, in 2007, GE Wind, a U.S. company; Gamesa, a Spanish company; and Vestas, a Danish company, held the fourth-, fifth-, and sixth-largest market shares in China's wind power market, respectfully.⁷¹

3. THE PATENT LAW

While the Contract Law, discussed earlier, contains specific provisions for technology transfer, the Patent Law of the People's Republic of China (Patent Law) represents a much more significant effort to reduce the risk associated with technology. The Patent Law, originally adopted in 1984, was amended in 2000⁷² in order to comply with TRIPS.⁷³ It was amended again in 2008,⁷⁴ and this section focuses on the 2008 amendment.

The 2008 Patent Law reflects China's efforts to foster and protect innovation. The purposes of the 2000 Patent Law were to "protect patent rights for inventions, encourage inventions and facilitate their popularization and application, encourage progress and innovation in science and technology, and meet the needs of socialist modernization."⁷⁵ The 2008 amendment, however, added the goal of "enhancing innovation capability."⁷⁶

With this goal in mind, several provisions in the amended Patent Law significantly mitigate the risk to the owners of IP in the process of technology transfer.⁷⁷ For example, the 2000 Patent Law stipulates that an invention must possess "novelty" in order to be patentable, but the law does not consider prior use or knowledge outside of China in determining novelty.⁷⁸ The amended 2008 Patent

⁷¹ Energy and Security Group, Int'l Trade Admin., *supra* note 13, at 45.

⁷² Patent Law, *supra* note 40.

⁷³ Bai et al., *supra* note 41, at 1.

⁷⁴ Patent Law, *supra* note 40.

⁷⁵ *Id.* at ch.1, art. 1.

⁷⁶ *Id.*

⁷⁷ This discussion of the significance of the 2008 amended Patent Law in general draws on analysis by Bai et al. Bai et al., *supra* note 41.

⁷⁸ Patent Law, *supra* note 40, at ch. 2, art. 22.

Law extends the standard for novelty to prior use or knowledge *outside* of China.⁷⁹ As Bai et al. explain, this new standard requires Chinese courts to consider public knowledge or use outside of China when assessing patent validity.⁸⁰ Under this new standard, foreign firms may draw on a broader body of prior art in challenging patents registered in China that they allege conflict with their own. While the 2000 law makes it illegal to make, sell, or import a product covered by a patent,⁸¹ the amended law expands this list of activities to include offering to sell a product covered by a patent,⁸² providing greater protection to both Chinese and foreign IP.

One aspect of the 2008 amendment to the Patent Law that could affect renewable energy technology is its provisions that relate to “genetic resources,”⁸³ as these provisions could have important risk implications in the biofuel industry. Biofuel firms are paying an increasing amount of attention to the use of genetic engineering in producing low-emission, “second-generation” biofuels,⁸⁴ and it is unclear how the 2008 Patent Law would treat such technology. The Patent law does not define “genetic resources,” yet it requires those who want to patent products that depend on genetic resources to disclose the source of those genetic resources, or at least explain why they cannot disclose the source.⁸⁵ At face value, this provision does not preclude biofuel firms from patenting their inventions, but it places an unusual burden on patent applicants,⁸⁶ and it forces them to reveal more of their IP than they had to under the 2000 amendment.

⁷⁹ *Id.*; see also Bai et al., *supra* note 41.

⁸⁰ Bai et al., *supra* note 41, at 1–2.

⁸¹ Patent Law, *supra* note 40, at ch. 1, art. 11.

⁸² *Id.*

⁸³ *Id.* at ch.3, art 26. Prior to the 2008 amendment, the Patent Law did not contain references to “genetic resources.”

⁸⁴ For example, at the 2009 Bio World Congress on Industrial Biotechnology, in July 2009, biotechnology firms gathered to discuss how genetic engineering and biotechnology could be used to produce second-generation biofuels. See, e.g., John Lorinc, *The Food, Energy and Environment ‘Trilemma,’* THE NEW YORK TIMES (July 31, 2009), <http://green.blogs.nytimes.com/2009/07/31/the-food-energy-and-environment-trilemma/>.

⁸⁵ Patent Law, *supra* note 40, at ch.3, art. 26.

⁸⁶ Bai et al., *supra* note 41, at 3 (noting that no such requirement exists in American, European, or Japanese patent law).

For this reason, this provision does increase the expected risk to foreign transferors of biofuel technology.

Despite this risk, however, the market for biofuels in China is relatively small, and so the risk that the Patent Law poses to biofuel firms is a small portion of total risk for non-Chinese renewable energy firms. For example, the World Energy Outlook 2007's Reference Scenario estimates that biofuels will account for only "2% of road fuel consumption" in China by 2030.⁸⁷

C. DEVELOPMENTS IN ENFORCEMENT

The legal reforms that China undertook in preparation to accede to the WTO and again in the latter half of the 2000s have improved protections for foreign IP in the letter of the law, but risk to foreign investors can only decrease if effective enforcement accompanies China's improved laws. According to data from Sepetys and Cox's 2009 analysis of IP litigation in China, based on data from 2002 to 2008, IP litigation in China produced predictable trends as of the late 2000s, making it easier for foreign firms to predict the outcome of IPR litigation.⁸⁸ First, the value of damages awarded by the courts has become more predictable. Damages in IPR cases in China tend to be low,⁸⁹ but although Sepetys and Cox argue that low damages fail to significantly deter infringers,⁹⁰ foreign firms are able to estimate the outcome of an IPR lawsuit. According to Sepetys and Cox, the median value of damages awarded for all IPR cases in China in 2006 and 2007 was close to \$15,000.⁹¹ This amount may seem low, but plaintiffs in China also tend to claim low damages,⁹² and the median value of damages awarded is equal to approximately

⁸⁷ INTERNATIONAL ENERGY AGENCY, *World Outlook*, *supra* note 55, at 299.

⁸⁸ Kristina Sepetys & Alan Cox, *Intellectual Property Rights Protection in China: Trends in Litigation and Economic Damages*, NERA ECONOMIC CONSULTING, 8 (2009), http://www.nera.com/extImage/PUB_IPR_Protection_China_0109_final.pdf.

⁸⁹ *Id.* at 6.

⁹⁰ *Id.*

⁹¹ *Id.* at 8.

⁹² *Id.*

15% of damages claimed.⁹³ At the very least, firms can factor in IPR litigation as a predictable cost of business.

Second, foreign firms seem to experience more favorable outcomes in IPR litigation than Chinese firms do. Sepetys and Cox note that in all the cases they examined in which the plaintiffs were Chinese, the median damages awarded equaled approximately 5% of median damages claimed.⁹⁴ In the cases they examined in which the plaintiffs were foreign, however, the median damages awarded equaled approximately 33% of damages claimed,⁹⁵ twenty-eight percentage points higher than the figure for Chinese plaintiffs.

Third, foreign firms are turning to Chinese courts more often, reflecting their confidence in the courts as a viable mechanism for resolving IPR disputes.⁹⁶ In China, IPR enforcement is handled by either the courts or by administrative agencies.⁹⁷ Sepetys and Cox note that from 2001—the year that China signed TRIPS—to 2008, there was a 50% annual increase in the number of IPR court cases involving foreign firms in China.⁹⁸

D. ABSORPTIVE CAPACITY

Although China made efforts to reform its IPR laws and improve enforcement, one of the most important reasons that foreign firms face a relatively low level of risk in transferring renewable energy technology to China has nothing to do with the law, but with “absorptive capacity.”⁹⁹ Cohen and Levinthal define absorptive capacity as “the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends.”¹⁰⁰ Most Chinese renewable energy firms have not developed

⁹³ *Id.*

⁹⁴ *Id.* at 13.

⁹⁵ *Id.*

⁹⁶ *See id.* at 4.

⁹⁷ *Id.*

⁹⁸ *Id.* at 5.

⁹⁹ *See generally* Copenhagen Economics, *supra* note 48, at 28–31.

¹⁰⁰ Wesley M. Cohen & Daniel A. Levinthal, *Absorptive Capacity: a New Perspective on Learning and Innovation*, 35 ADMIN. SCI. Q. (SPECIAL ISSUE) 128, 128 (1990).

the capability, or absorptive capacity, to effectively turn IP acquired from foreign firms into marketable products or services.

While China generates more electricity from renewable sources than any other country in the world,¹⁰¹ China's renewable energy industry is not as technologically advanced as that of some other countries that make significant use of renewable sources of energy. For example, China's energy consumption comes largely from coal,¹⁰² rather than from renewable sources; based on available data, China's share of electricity generated from renewable sources was below the world average eighteen out of nineteen years between 1991 and 2009.¹⁰³ China is the world's largest consumer of biomass, but that biomass is almost entirely traditional biomass, and only 1.5% of China's biomass was used in power generation in 2005.¹⁰⁴

Patent and market share data also show that China lags behind many industrialized countries in renewable energy technology. In Lee et al., figure 2.7 shows that, as of 2009, China held significant shares of worldwide patents in various renewable energy technologies, including over 10% of worldwide patents in wind power, biomass, and CSP.¹⁰⁵ When those numbers are adjusted to account for the geographic origin of the parent companies, Chinese companies still hold approximately 5% to 8% of global patents in

¹⁰¹ According to data from the U.S. Energy Information Administration, China's net electricity generation from renewable sources was more than that of any other country in the world between 2005 and 2010. See U.S. EIA, *Total Renewable Electricity*, *supra* note 52 (shown in billion kilowatthours). Note that at the time of this writing, the U.S. Energy Information Administration did not provide data for years beyond 2010.

¹⁰² In 2006, 70% of China's energy consumption came from coal. U.S. Energy Info. Admin., *Country Analysis Briefs: China*, U.S. DEPT. OF ENERGY, 1 (2010), <http://www.eia.gov/countries/analysisbriefs/China/china.pdf>. Note that the figures updated since the writing of this paper are consistent with the 2006 figures noted here.

¹⁰³ The author's calculations are based on data from the U.S. Energy Information Administration. See U.S. EIA, *Total Renewable Electricity*, *supra* note 52. Note that at the time of this writing, the U.S. Energy Information Administration did not provide the data necessary for calculations for years beyond 2009.

¹⁰⁴ INTERNATIONAL ENERGY AGENCY, *World Outlook*, *supra* note 55, at 354.

¹⁰⁵ Lee et al. *supra* note 57, at 15 fig.2.7.

those technologies,¹⁰⁶ but the shares of Japan and the United States increase dramatically relative to those of China after the adjustment.¹⁰⁷ In addition, the data in figure 2.7, at face value, suggests that China's renewable energy sector is more technologically advanced than that of the United Kingdom, France, Canada, South Korea, Italy, Russia, and India, as China's patent share is greater than the patent share of any of those countries in all the categories listed except carbon capture.¹⁰⁸ As of 2011, however, China's economy was 2.6 times larger than that of France,¹⁰⁹ the country in the above list with the largest economy,¹¹⁰ suggesting that China does not produce as much IP per unit of GDP as those other countries. In an environment with less density of innovation, Chinese firms cannot simply acquire IP from firms in industrialized countries and turn it into marketable products and services, because those industrialized countries have developed webs of renewable energy technology that depend on complementary technology for support.

If renewable energy in China were as technologically advanced as it is in industrialized countries, more Chinese companies would occupy top market positions in China. For example, in the wind turbine generator industry one-third of the leading companies were foreign as of 2008.¹¹¹

If Chinese renewable energy firms were able to integrate foreign IP into their operations fluidly, there would be large markets for pirated renewable energy IP in China. USTR periodically reports lists of "notorious markets" around the world, in which IPR infringement is particularly widespread, but no such renewable energy market is included in the most recent list.¹¹² China contained

¹⁰⁶ *Id.*

¹⁰⁷ *Id.*

¹⁰⁸ *Id.*

¹⁰⁹ See GDP (current US\$), WORLD BANK (last visited Sept. 30, 2012) <http://data.worldbank.org/indicator/NY.GDP.MKTP.CD>. Note that at the time of this writing, the World Bank did not provide data for years beyond 2011.

¹¹⁰ *Id.*

¹¹¹ See Energy and Security Group, Int'l Trade Admin., *supra* note 13, at 45.

¹¹² See OFFICE OF THE U.S. TRADE REPRESENTATIVE, EXEC. OFFICE OF THE PRESIDENT, OUT-OF-CYCLE REVIEW OF NOTORIOUS MARKETS (Feb. 28,

eight out of the thirty-three notorious markets listed in 2011,¹¹³ but these markets are primarily for consumer products such as mp3s,¹¹⁴ products of a very different nature than energy technology. In the data that Sepetys and Cox consider, the companies that appear most frequently in IPR litigation are in the entertainment and apparel industries;¹¹⁵ it is not surprising that these industries are frequent targets for IPR infringers. Pirating mp3s or DVDs, or counterfeiting shoes or handbags, for example, are activities that can be done with simple, widely available technology at a low cost. The generation, transmission, distribution, and sale of power from renewable energy sources, however, requires a vast, complex network of products, processes, trade secrets, and know-how. Without a strong base of its own complementary technology, a Chinese renewable energy firm that gains access to one piece of foreign technology cannot necessarily integrate that piece of technology into its operations.

Black markets valued at tens of millions of dollars and above exist for simple consumer goods in China, such as books, movies, music, software, and video games,¹¹⁶ but those goods are already end-use consumer products and can be sold easily. If a buyer in China purchases counterfeit DVDs, for example, he can use those products immediately, without any intermediate steps. If a buyer purchases stolen information regarding the chemical composition of a biofuel, however, that buyer must have a very specialized set of complementary skills, know-how, and equipment in order to make use of that information.

Weak absorptive capacity also mitigates the risk that Article 329 of the Contract Law and the various provisions of the Anti-Monopoly Law pose, discussed previously. While Chinese firms may be able to engineer technological improvements to IP acquired from foreign

2011), *available at* <http://www.ustr.gov/about-us/press-office/reports-and-publications/2011/>.

¹¹³ *Id.* Calculation does not include Hong Kong.

¹¹⁴ *Id.*

¹¹⁵ *See* Sepetys & Cox, *supra* note 88, at 9.

¹¹⁶ As of September 6, 2012, the black markets for these goods in China equaled \$52 million (books), \$565 million (movies), \$466.3 million (music), \$8.9 billion (software), and \$589.9 million (video games). *China Black Markets*, HAVOSCOPE, <http://www.havocscope.com/tag/china/> (last visited Sept. 30, 2012).

sources, these Chinese firms must be able to sell or make use of those improvements in order to profit from them.

III. RETURN FACTORS

Now that this article has examined the risks that owners of renewable energy IP may consider before exposing that IP to the Chinese market, it turns to return factors. Are IPR a significant barrier to non-Chinese renewable energy firms who want to earn a satisfactory return in the Chinese market? In China, the potential for growth in the renewable energy sector, the extent of competition among firms in the sector, and the incentives for foreign firms to partner with Chinese firms lead to an expected return that outweighs concerns about IPR.

A. PROSPECTS FOR GROWTH

Non-Chinese owners of renewable energy IP can expect China's renewable energy sector to continue to grow, as China's leadership has pledged to support the sector. China has generated tremendous economic growth since it began major economic reforms in 1978,¹¹⁷ and rapidly increasing demand for energy has accompanied those increasing levels of economic activity. For example, total primary energy consumption in China more than quintupled from 1980 to 2009,¹¹⁸ and energy demand in China continues to accelerate. In the period from 2000 to 2009 alone, China experienced over 2.6 times as

¹¹⁷ See *GDP Growth (Annual %)*, WORLD BANK, <http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG> (last visited Sept. 30, 2012) (comparing rates, showing that China's annual GDP growth rate averaged 9.99% from 1980 to 2011). Note that at the time of this writing, the World Bank did not provide data for years before 1980 or after 2011.

¹¹⁸ See U.S. Energy Info. Admin., *International Energy Statistics - Total Primary Energy Consumption*, U.S. DEPT. OF ENERGY, <http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=44&pid=44&aid=2&cid=CH,&syid=1980&eyid=2009&unit=QBTU> (last visited Sept. 30, 2012) (provided in quadrillion Btu). Note that at the time of this writing, the U.S. Energy Information Administration did not provide relevant data for years beyond 2009.

much growth in primary energy consumption as it had in the preceding twenty years.¹¹⁹

China's Five-Year Plans,¹²⁰ which outline high-level official priorities, guidelines, and goals for China's national development, call for increased development of renewable energy. For example, the Eleventh Five-Year Plan, which covers the period from 2006–2010, cites high levels of energy resource consumption as a problem that emerged during the rapid development of the period from 2001–2005¹²¹ and calls for the “implementation of preferential financial, tax, and investment policies and mandatory market share policies, the encouragement of renewable energy generation and consumption, and increasing the proportion of [renewable energy] in primary energy.”¹²² The most recent plan, the Twelfth Five-Year Plan,¹²³ which covers the period from 2011–2015, calls for an increase in the proportion of renewable energy consumption in primary energy consumption¹²⁴ and calls for an “emphasis on the development of a new generation of nuclear power, the generation of electricity from solar thermal energy and photovoltaic thermal energy, wind power technology and equipment, a smart grid, and energy from biomass.”¹²⁵

Additional official documents elaborate on the guidelines stipulated in the Five-Year Plans. For example, the Medium- to Long-Term Renewable Energy Development Plan of China's State Council, the chief executive agency of the government, stipulates specific targets in the installed capacity of various sources of

¹¹⁹ See *id.* (showing that from 1980 to 1999, China's total primary energy demand increased by 19.95 quadrillion Btu, and from 2000 to 2009, it increased by 53.06 quadrillion Btu).

¹²⁰ See Eleventh Five-Year Plan, *supra* note 60.

¹²¹ *Id.* at ch. 1, § 1.

¹²² *Id.* at ch. 3, § 12(4).

¹²³ Outline of the Twelfth Five-Year Plan for National Economic and Social Development, *Zhonghua renmin gongheguo guomin jingji he shehui fazhan di shier ge wu nian guihua gangyao* (中华人民共和国国民经济和社会发展第十二个五年规划纲要) [National development and social development in the Twelfth Five-Year Plan Outline] (promulgated by National People's Cong., Mar. 16, 2011), Xinhua News Agency (China), available at http://www.gov.cn/2011lh/content_1825838.htm.

¹²⁴ *Id.* at ch. 1, § 3.

¹²⁵ *Id.* at ch. 1, § 10.

renewable energy.¹²⁶ The Renewable Energy Law of the People's Republic of China¹²⁷ (Renewable Energy Law) also contributes to the supportive policy framework for renewable energy.¹²⁸ It mandates grid access for renewable electricity¹²⁹ and establishes a feed-in tariff¹³⁰ to ensure that there are buyers for renewable electricity. It also encourages preferential loans for renewable energy projects,¹³¹ and it commits the government to offering renewable energy project tax benefits,¹³² which have been implemented for a wide variety of renewable energy technologies.¹³³ The Renewable Energy Law also establishes funding for research, development, and demonstration in renewable energy technology.¹³⁴

B. COMPETITIVE PRICING

As mentioned previously, actors in China have argued that IPR are a barrier to technology transfer because firms with exclusive rights to their IP are able to charge prices for their technology that are too high for developing countries to afford. In China's renewable energy market, however, there is enough competition and diversity in the renewable energy market that monopolistic pricing is not possible.

¹²⁶ Medium- to Long-Term Renewable Energy Development Plan, Kezaisheng nengyuan zhongchangqi fazhan guihua (可再生能源中长期发展规划) [Renewable energy and long-term development planning] (promulgated by State Council of the People's Republic of China, effective June 7, 2007), available at <http://img2.dichan.com/docs/2010/1/30/20100130231553858005.pdf>.

¹²⁷ Zhonghua renmin gongheguo ke zai sheng nengyuan fa (中华人民共和国可再生能源法) [Renewable Energy Law of the P.R.C.] (promulgated by the Standing Comm. Nat'l People's Cong. Feb. 28, 2005, effective Jan. 1, 2006) (China) [hereinafter Renewable Energy Law], available at http://www.npc.gov.cn/englishnpc/Law/2007-12/13/content_1384096.htm.

¹²⁸ For a detailed discussion of the provisions of the Renewable Energy Law, see Energy and Security Group, Int'l Trade Admin., *supra* note 13, at 27–28.

¹²⁹ Renewable Energy Law, *supra* note 127, at ch. 4, art. 14.

¹³⁰ *Id.* at ch. 5, art. 19.

¹³¹ *Id.* at ch. 6, art. 25.

¹³² *Id.* at ch. 6, art. 26.

¹³³ See Energy and Security Group, Int'l Trade Admin., *supra* note 13, at 29–30.

¹³⁴ Renewable Energy Law, *supra* note 127, at ch. 3, art. 12.

Premiums on IP have been brought down to competitive levels, and foreign firms can expect reasonable returns under these market conditions.

Data reported by the ITA shows that no foreign firms dominate any of the various renewable energy markets in China. For example, in the wind power market, there were “over 80 wind turbine generator manufacturers and 200 wind developers” as of 2008 and Chinese companies occupied over 75% of the market.¹³⁵ Furthermore, according to the World Energy Outlook 2007, competition between Chinese and foreign firms in the wind power market may “put downward pressure on turbine prices.”¹³⁶ Chinese companies also dominate the market in solar power and hydropower.¹³⁷

In those industries where prices are still high, Copenhagen Economics and ApS note that high costs are more likely due to the immaturity of the technologies than to premiums on IP.¹³⁸ The same report notes that China has been able to take advantage of certain kinds of technology at a lower cost than others, even with a premium on IP, because the efficiency of those technologies drives prices down.¹³⁹ The World Business Council for Sustainable Development notes that “royalty costs for energy patents [represent] a small percentage of the total investment cost,”¹⁴⁰ and Lee et al. elaborate on this point by explaining that it is the lack of capital and management, rather than IPR premiums, that bars energy technology transfer to developing countries.¹⁴¹

¹³⁵ Energy and Security Group, Int’l Trade Admin., *supra* note 13, at 45.

¹³⁶ INTERNATIONAL ENERGY AGENCY, *World Outlook*, *supra* note 55, at 355.

¹³⁷ Energy and Security Group, Int’l Trade Admin., *supra* note 13, at 44–48.

¹³⁸ Copenhagen Economics, *supra* note 48, at 16.

¹³⁹ *Id.* at 17.

¹⁴⁰ *Towards a Low-Carbon Economy: a Business Contribution to the International Energy & Climate Debate*, WORLD BUSINESS COUNCIL FOR SUSTAINABLE DEVELOPMENT, 9 (2009), <http://www.wbcsd.org/Page.s/EDocument/EDocumentDetails.aspx?ID=10987&NoSearchContextKey=true>.

¹⁴¹ Lee et al., *supra* note 57, at 8.

C. INCENTIVES TO PARTNER

Foreign firms stand to gain greater returns in the long run when they share or develop IP with Chinese partner companies than when they try to deal with Chinese companies at arm's length in order to protect their IP. The traditional arguments for why IPR are a barrier to technology transfer assume IP originates entirely from foreign firms and moves entirely into the hands of Chinese firms, but in reality, the relationship is more complex. In a sector that requires a complex body of specialized, interdependent technology and a business environment that values relationships, foreign firms that commit to sharing or developing their IP with Chinese partners can create relationships in which neither partner has an incentive to jeopardize the relationship.

Chinese companies can offer certain complementarities to foreign companies that make partnerships profitable. Chinese companies can help foreign companies navigate the local cultural environment and provide networks of local industry contacts, and they can provide cheaper labor and management than companies from industrialized countries would find at home. Indeed, four out of the fourteen leading companies in wind turbine generator technology listed in the ITA's 2008 report are joint ventures between a Chinese company and a foreign company.¹⁴²

Also, in an artificial but practical sense, Chinese companies help foreign companies meet local content requirements. For example, Chinese regulations require foreign wind turbine manufacturers to manufacture a certain percentage of their equipment in China,¹⁴³ and one convenient way for foreign firms to meet these requirements is to form partnerships with local manufacturers.

While this article considers partnerships as a return factor, they are also a risk factor. Partnerships not only create profitable business models, but also mitigate the risk that the Chinese companies will misappropriate the IP of their foreign counterparts. First, maintaining trust and reliability in these partnerships is key to success, and IP theft can jeopardize such a relationship. Second, as

¹⁴² Energy and Security Group, Int'l Trade Admin., *supra* note 13, at 46.

¹⁴³ See, e.g., INTERNATIONAL ENERGY AGENCY, *World Outlook*, *supra* note 55, at 355–56.

discussed earlier, many Chinese firms do not have the absorptive capacity to turn stolen IP directly into marketable products and services. They are dependent on their foreign counterparts for complementary technology, just as the foreign firms are dependent on them for their low costs and knowledge of the local business environment.

IV. EMPIRICAL AND ANECDOTAL EVIDENCE

A. EMPIRICAL EVIDENCE FOR CONFIDENCE IN THE IPR REGIME

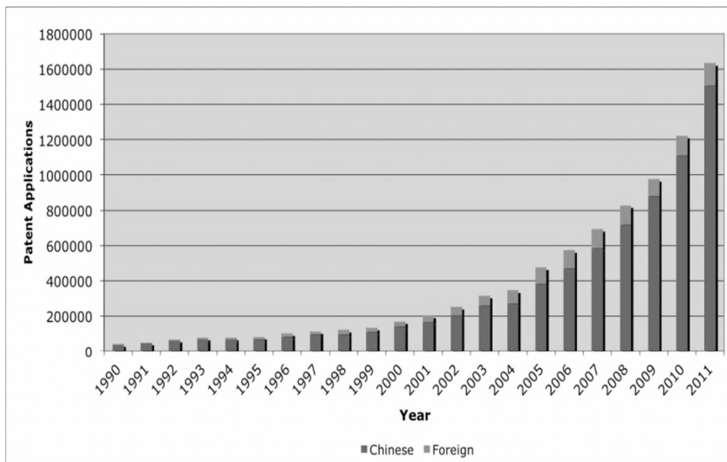
The number of patent applications filed in China, including applications filed by foreign firms, has increased significantly since the early 2000s, reflecting increased confidence in the environment for IPR in China. Filing patent applications requires time and money, and firms have less of an incentive to file patent applications if they do not believe that there is a reasonable chance those patents will be enforced.

Figure 3 shows the total number of patent applications filed in China and the respective shares of foreign and Chinese patent applications in total patent applications in China over the period 1990–2011.¹⁴⁴ Prior to China's accession to the WTO, foreign patent applications reached a maximum of 30,343 and total patent

¹⁴⁴ Data in Figures 3, 4, and 5 come from both the China Statistical Yearbooks and the State Intellectual Property Office. Pre-2000 data come from the yearbooks and data from 2000 onward come from the State Intellectual Property Office. See *Statistics*, STATE INTELLECTUAL PROPERTY OFFICE OF THE P.R.C., <http://English.sipo.gov.cn/statistics/> (last visited Jan. 3, 2012); National Bureau of Statistics of China, *China Statistical Yearbook 1999*; National Bureau of Statistics of China, *China Statistical Yearbook 1998*; National Bureau of Statistics of China, *China Statistical Yearbook 1997*; National Bureau of Statistics of China, *China Statistical Yearbook 1996*; National Bureau of Statistics of China, *China Statistical Yearbook 1995*; National Bureau of Statistics of China, *China Statistical Yearbook 1994*; National Bureau of Statistics of China, *China Statistical Yearbook 1993*; National Bureau of Statistics of China, *China Statistical Yearbook 1992*; National Bureau of Statistics of China, *China Statistical Yearbook 1991*; National Bureau of Statistics of China, *China Statistical Yearbook 1990*. Annual statistics published in the China Statistical Yearbooks can also be found at <http://www.stats.gov.cn/english/statisticaldata>.

applications reached a maximum of 170,682; by 2011, those figures climbed to 128,677 and 1,633,347, respectively.¹⁴⁵

Figure 3 **Total Patent Applications in
China by Year, 1990-2011**



Sources: China Statistical Yearbook, State Intellectual Property Office

These data aggregate all types of patent applications in China (invention patents, design patents, and utility model patents), but Yang explains that foreign firms have filed much lower numbers of applications for utility model patents in China than Chinese firms have.¹⁴⁶ Yang attributes this trend to the fact that most foreign patent systems do not have an equivalent to the utility model patent, causing some foreign firms to not understand them.¹⁴⁷ As such, applications for utility model patents have limitations as a proxy for foreign confidence in China's IPR system. Figure 4 modifies the data in

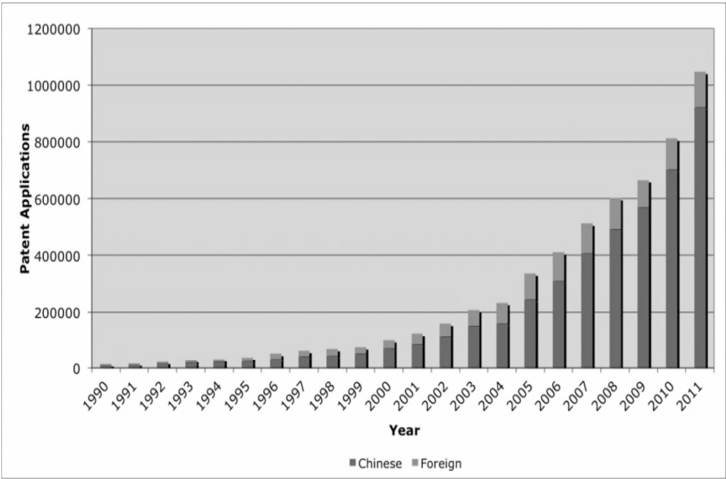
¹⁴⁵ *Id.*

¹⁴⁶ Stephen Yang, *Utility Model in China – an Overlooked but Powerful Tool*, MANAGING INTELLECTUAL PROPERTY, (Apr. 1, 2009), <http://www.managingip.com/Article/2176035/An-overlooked-but-powerful-tool.html>.

¹⁴⁷ *Id.*

Figure 3 by removing utility model patent applications, and it shows an increase in the share of foreign patent applications.

Figure 4 **Total Patent Applications in
China by Year Excluding
Applications for Utility Model
Patents, 1990-2011**



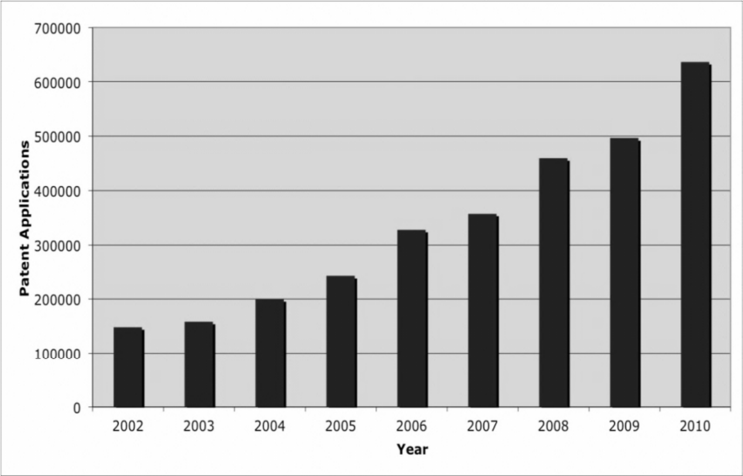
Sources: China Statistical Yearbook, State Intellectual Property Office

Another limitation of the data in these figures is that they include applications for patents related to all kinds of technology, not just renewable energy technology. Drawing on data from the China Statistical Yearbook, I selected eighty-nine classifications of patents that have potential applications in renewable energy technology,¹⁴⁸ as they constitute a more representative sample of trends in renewable energy patenting. Figure 5 shows applications by year for these eighty-nine selected patent types over the period of 2002–2010. The sample is not a perfect proxy for renewable energy technology, and it

¹⁴⁸ I selected the eighty-nine patent classifications in consultation with Dr. Kelly Sims Gallagher, Associate Professor of Energy and Environmental Policy, the Fletcher School, Tufts University.

does not distinguish between foreign and Chinese applications, as this data is not available for most years. Conclusions should be drawn from this data with caution, but the data offers a closer picture of trends in renewable energy technology transfer than do all the patent data aggregated together, and they show a steady increase in applications over the period considered.

Figure 5 Applications for Selected Categories of Patents with Potential Applications in Renewable Energy Technology, 2002-2010



Sources: China Statistical Yearbook, State Intellectual Property Office

Overall, the evidence suggests that foreign confidence in China’s IPR regime has increased significantly over the reform period, including in renewable energy. Legal reforms, developments in enforcement, and low absorptive capacity have mitigated the extent to which concerns about IPR present risk to foreign transferors of technology.

B. ANECDOTAL EVIDENCE FOR CONFIDENCE IN THE IPR REGIME

This section considers the experiences of three energy companies—U.S. solar power company GT Solar, Danish wind power company Vestas, and U.S. energy company General Electric—as they have developed their renewable energy operations in China. These three companies do not represent the full range of experiences that foreign renewable energy companies have had in China, but they represent examples of companies that are confident enough in China’s environment for IP that they have been willing to transfer their IP into the Chinese market. Furthermore, all three of these companies have dramatically expanded their renewable energy operations in the latter half of the 2000s, as soaring demand for energy in China has created greater demand for renewable energy and the new policy framework has put in place stronger incentives to invest.

1. GT SOLAR

In 2006, GT Equipment Technologies changed its name to GT Solar (GT).¹⁴⁹ CEO Kedar Gupta explained the rationale behind the name change in a 2006 press release:

This name change reflects the fact that most of the business we're conducting around the globe is in the solar, or photovoltaic, energy industry It's one of the fastest growing industries in the world, and GT Solar has become an industry leader. Our name now makes it clear that we are in the business of enabling technology, manufacturing

¹⁴⁹ *GT Equipment Technologies is Now “GT Solar,”* BUS. WIRE, Aug. 23, 2006, available at <http://www.businesswire.com/portal/site/gtsolar/>. GT Solar then changed its name to GT Advanced Technologies in 2011. This section focuses on the company’s activities during the time that it was called GT Solar. Press Release, GT Advanced Technologies, GT Solar Completes Name Change to GT Advanced Technologies (Aug. 8, 2011), <http://investor.gtat.com/phoenix.zhtml?c=211850&p=irol-newsArticle&ID=1594054&highlight=>.

and equipment solutions for the solar industry worldwide.¹⁵⁰

In the process of “enabling technology, manufacturing and equipment solutions for the solar industry worldwide,”¹⁵¹ the favorable conditions for technology transfer and the renewable energy industry discussed earlier in this article allowed GT to make major inroads in the solar photovoltaic market and invest in the transfer of technology to China.

GT signed its first contract in China in 2002,¹⁵² and in the period from November 2004 to February 2010, GT signed at least nine contracts with Chinese firms, for a total value of approximately \$418 million.¹⁵³ Moreover, as GT did more and more business in China over this period, it quickly transferred an increased amount of technology. In 2004, GT signed a contract to sell direct solidification

¹⁵⁰ BUS. WIRE., *GT Equipment Technologies is Now “GT Solar,” supra* note 149.

¹⁵¹ *Id.*

¹⁵² Press Release, GT Advanced Technologies, GT Solar Ships 1,000th DSS450 Crystalline Ingot Growth Furnace (July 12, 2010), http://investor.gtat.com/phoenix.zhtml?c=211850&p=irol-newsArticle_print&ID=1446331&highlight=.

¹⁵³ See *GT Equipment Signs over \$33 Million Contract with Chinese Co.; LDK Solar Hi-Tech Co., Ltd. To Buy 75 MW Solar Wafer Fabrication Line*, BUS. WIRE, Aug. 10, 2005, <http://www.businesswire.com/portal/site/gtsolar/>; *GT Solar to Equip One of Largest Solar Wafer Factories in World*, BUS. WIRE, July 31, 2007, <http://www.businesswire.com/portal/site/gtsolar/>; *GT Solar and Jiangxi Sornid Hi-Tech Co., Ltd. Announce New Order Totaling More than \$20 Million for GT Solar’s GT-DSS450 Ingot Growth Furnace*, BUS. WIRE, Feb. 17, 2010, <http://www.businesswire.com/portal/site/gtsolar/>; *GT Solar Signs Polysilicon Reactor Contract With Chinese Company*, BUS. WIRE, June 11, 2007, <http://www.businesswire.com/portal/site/gtsolar/>; *GT Solar Signs More than \$40 Million in New Contracts with GCL-Poly*, BUS. WIRE, Jan. 19, 2010, <http://www.businesswire.com/portal/site/gtsolar/>; *GT Solar Technologies Signs \$9.5 million Contract in China; Baoding Tianwei Ying li of China Adds Wafer Capacity for Solar Cells*, BUS. WIRE, Nov. 12, 2004, <http://www.businesswire.com/portal/site/gtsolar/>; *GT Solar & Trina Solar Sign \$49MM Polysilicon Reactor Contract*, BUS. WIRE, Mar. 11, 2008, <http://www.businesswire.com/portal/site/gtsolar/>; *GT Solar & Yingli Green Energy Sign \$56M Silicon Furnace Contract*, BUS. WIRE, Nov. 26, 2007, <http://www.businesswire.com/portal/site/gtsolar/>.

system furnaces to Baoding Tianwei Yingli New Energy Resources.¹⁵⁴ In July 2007, GT signed contracts to sell a more advanced model to two Chinese companies: Glory Silicon Energy and Yingli Green Energy.¹⁵⁵

Each of these three contracts is a relatively restricted example of technology transfer, as GT was simply transferring equipment, rather than developing it with a Chinese partner or teaching a Chinese partner how to improve upon it, but GT has also engaged in broader technology transfer. In 2005, GT began transferring more tacit knowledge through a contract to create a 75MW wafer fabrication turnkey line for the Chinese firm LDK.¹⁵⁶ At first glance, this may seem like another example of very basic technology transfer, but GT transferred more than just equipment in this arrangement. According to GT's Project Manager for the LDK facility, Charles Hagopian, "GT was involved from the very beginning with LDK Solar in the design of its factory, the installation of GT's equipment, and the training of LDK's employees."¹⁵⁷ More recently, under two 2010 contracts with subsidiaries of a Chinese firm, GCL-Poly Energy Holdings, GT committed to transferring "equipment, technology, and know-how" to the two subsidiaries.¹⁵⁸

GT also established a base in China from which to facilitate the diffusion of technology. In 2006, GT established GT Solar (Shanghai) Co., Ltd., with offices in Shanghai and Beijing,¹⁵⁹ and in 2008, GT announced plans to build and operate a polysilicon facility

¹⁵⁴ BUS. WIRE, *GT Solar Technologies Signs \$9.5 million Contract in China; Baoding Tianwei Yingli of China Adds Wafer Capacity for Solar Cells*, *supra* note 153.

¹⁵⁵ BUS. WIRE, *GT Solar to Equip One of Largest Solar Wafer Factories in World*, *supra* note 153; BUS. WIRE, *GT Solar & Yingli Green Energy Sign \$56M Silicon Furnace Contract*, *supra* note 153.

¹⁵⁶ BUS. WIRE, *GT Equipment Signs over \$33 Million Contract with Chinese Co.; LDK Solar Hi-Tech Co., Ltd. to Buy 75 MW Solar Wafer Fabrication Line*, *supra* note 153.

¹⁵⁷ *GT Solar Technologies Installs Turnkey Solar Wafer Line At LDK Solar; LDK Solar, China, Begins Production of One of World's Largest Solar Manufacturing Lines*, BUS. WIRE, May 4, 2006, <http://www.businesswire.com/portal/site/gtsolar/>.

¹⁵⁸ BUS. WIRE, *GT Solar Signs More than \$40 Million in New Contracts with GCL-Poly*, *supra* note 153.

¹⁵⁹ *GT Solar Expands Presence in China*, BUS. WIRE, Dec. 28, 2006, <http://www.businesswire.com/portal/site/gtsolar/>.

in Lianyungang municipality, Jiangsu province.¹⁶⁰ Finally, in 2009, GT opened its Asian headquarters in Shanghai, a facility that GT intends to use “to provide product demonstrations and training” to Asian customers.¹⁶¹

These incremental increases in the quality of technology transfer would not have occurred if GT was not confident that China would protect GT’s IPR or that it would not receive an acceptable return on its investment. GT’s experience with technology transfer was limited, but it grew incrementally. GT did not go so far as to form any joint ventures in China, but IPR were not a barrier to its operations there, and it has taken advantage of increasing opportunities for deeper technology transfer.

2. VESTAS

Vestas, the eighth-largest firm in the Chinese wind power market as of 2011,¹⁶² also took advantage of the environment for renewable energy in China. While its position has slipped since, Vestas reached the number-two position in 2006;¹⁶³ in the process, it sold more advanced technology to its customers in China and took a greater interest in transferring know-how, as well.

Lewis notes that Vestas is relatively conservative about importing its IP into China, preferring to retain ownership over its technology.¹⁶⁴ However, like GT, Vestas benefited from transferring

¹⁶⁰ BUS. WIRE, *GT Solar & Trina Solar Sign \$49MM Polysilicon Reactor Contract*, *supra* note 153.

¹⁶¹ *GT Solar Opens New Asia Headquarters in Shanghai*, BUS. WIRE, Sept. 7, 2009, <http://www.businesswire.com/portal/site/gtsolar/>.

¹⁶² *China World’s Wind Power Leader*, XINHUA (Mar. 23, 2012), http://www.china.org.cn/environment/2012-03/23/content_24970321.htm.

¹⁶³ Joanna I. Lewis, *A Comparison of Wind Power Industry Development Strategies in Spain, India and China*, CENTER FOR RESOURCE SOLUTIONS, 15 fig.8 (2007), <http://www.resourcesolutions.org/lib/librarypdfs/Lewis.Wind.Industry.Development.India.Spain.China.July.2007.pdf>.

¹⁶⁴ See Joanna I. Lewis, *From Technology Transfer to Local Manufacturing: China’s Emergence in the Global Wind Power Industry*, Presentation at the Woodrow Wilson Center’s China Environment Forum at 9 (Oct. 2, 2006), available at <http://www.wilsoncenter.org/events/doc/s/CEF.Talk.Lewis.10.06.ppt>.

increasingly sophisticated equipment to its Chinese customers. On December 17, 2009, Vestas announced that it recently received the first order for its V60-850 kW turbine, designed specifically for Chinese customers, from China Datang Renewable Power Co., Ltd. (Datang).¹⁶⁵ Just eleven days later, Vestas announced that Datang ordered a line of more advanced turbine from Vestas, the V90-2.0 MW turbine.¹⁶⁶

Vestas was actually transferring softer technology to China as early as 2007. Vestas opened two manufacturing facilities in Tianjian in 2007: a generator factory and a factory for the assembly of nacelles and hubs.¹⁶⁷ In order to prepare the Tianjin facility to begin manufacturing V52-850 kW turbines, Vestas invited Chinese employees to its nacelle factory in Taranto, Italy to train with the Italian team for two months.¹⁶⁸

While Vestas's experience with technology transfer is not as deep as GT's, its decision to abandon its restrictive model of technology transfer reflects that it recognized that its future in China requires greater Chinese ownership of its know-how.

3. GENERAL ELECTRIC

General Electric (GE) has been doing business in China for over 100 years,¹⁶⁹ and it has proactively taken advantage of the favorable

¹⁶⁵ Press Release, Vestas, Vestas Receives First Order for Its Made-for-China Wind Turbine (Dec. 17, 2009), http://www.vestas.com/files//Filer/EN/Press_releases/Local/2009/CH_091217_LPR_UK_07.pdf.

¹⁶⁶ Press Release, Vestas, Valued Chinese partner shows confidence in Vestas product line (Dec. 28, 2009), a http://www.vestas.com/files//Filer/EN/Press_releases/Local/2009/CH_091228_LPR_UK_08.pdf.

¹⁶⁷ Press Release, Vestas, Customer day at Vestas' manufacturing facilities in Tianjin, China (Sept. 20, 2007), http://www.vestas.com/files//Filer/EN/Press_releases/Local/2007/AP070920LPMUK01.pdf.

¹⁶⁸ Vestas, *Taranto Technology Transfer*, 12 WIND, OIL, & GAS, May 2008, at 45, available at <http://nozebra.ipapercms.dk/Vestas/VestasWind/UK/1208/?Page=43>.

¹⁶⁹ GE, *People's Republic of China Sign Memorandum of Understanding on Environmental Technology; Energy, Water, Rail, Aviation, Lighting Opportunities Included; Energy and Environment Research Pact with Tsinghua University Also Signed*, BUS. WIRE, May 29, 2006, http://www.businesswire.com/portal/site/ge/index.jsp?ndmViewId=news_view&newsId=20060528005017&newsLang=en&ndmConfigId=10011

environment for renewable energy in China in the last few years. In a September 2009 interview, Tim Schweikert, president of GE Transportation China, said that GE views China as its “second home market,” because of China’s size and growth.¹⁷⁰ GE made technology transfer a regular part of its business in China, but GE only recently moved into renewable energy technology transfer in China. Unlike GT, which specializes entirely in renewable energy technology, GE has a wide variety of operations in different energy sources, such as oil and gas.

GE laid the groundwork for technology transfer in China in the early 2000s, but it did not fully commit itself to renewable energy in China. In 2000, GE established the China Technology Center in Shanghai,¹⁷¹ although the center only played a supporting role in research at the time.¹⁷² GE was also providing gas turbines and related equipment to Chinese firms in the early 2000s,¹⁷³ and some GE turbines had been assembled in China as of 2006, under a technology transfer agreement.¹⁷⁴

GE then strengthened its relationships in China by signing a memorandum of understanding with China’s National Development and Reform Commission in 2006.¹⁷⁵ The motivation for the agreement, according to GE, was “the growing synergy between China’s needs and GE technology, explicitly allowing for GE to

09&vnsId=681.

¹⁷⁰ Jialu Chen, ‘Global Reset’ Sees China Poised for Growth, CHINA DAILY, Sept. 12, 2009, http://www.chinadaily.com.cn/china/2009summerdavos/200909/12/content_8684235.htm.

¹⁷¹ Kevin Bullis, *GE to Boost Research in China*, TECH. REV., Apr. 8, 2010, <http://www.technologyreview.com/energy/25008/>.

¹⁷² *Id.*

¹⁷³ *GE Wins Contracts of US\$900M to Supply Gas Turbines for Power Plants in China*, BUS. WIRE, Mar. 7, 2003, [http://www.thefreelibrary.com/GE+Wins+Contracts+of+US\\$900M+to+Supply+Gas+Turbines+for+Power+Plants...-a098467131](http://www.thefreelibrary.com/GE+Wins+Contracts+of+US$900M+to+Supply+Gas+Turbines+for+Power+Plants...-a098467131).

¹⁷⁴ *GE, NTC Shipped First China-Assembled 9E Gas Turbine*, GE IN CHINA, no. 10 (Gen. Elec., Fairfield, Conn.), July, 2006, available at <http://www.ge.com.cn/enewsletter/geinchina10.htm#business3>.

¹⁷⁵ BUS. WIRE, *GE, People’s Republic of China Sign Memorandum of Understanding on Environmental Technology; Energy, Water, Rail, Aviation, Lighting Opportunities Included; Energy and Environment Research Pact with Tsinghua University Also Signed*, *supra* note 169.

provide advanced technologies to China,” including renewable energy technology.¹⁷⁶ Under the agreement, GE agreed to provide up to \$50 million in funding for “eco-related” research to the China Technology Center, as well as management and leadership training for up to 2,500 Chinese managers and leaders, through 2011.¹⁷⁷ GE itself explained that this increasing cooperation with China is the result of policy and financial incentives put in place by the Chinese government, as well as a synergy that enhances GE’s bottom line.¹⁷⁸ Most recently, in August 2009, GE Drivetrain Technologies, a unit of GE Transportation, formed a joint venture with a Chinese company, Chongqing XinXing Fengneng Investment Co., Ltd. (XinXing), to produce drivetrain gears for wind turbines in China.¹⁷⁹ Under the terms of the agreement, XinXing is the majority shareholder in the joint venture,¹⁸⁰ reflecting GE’s willingness to invest in technology transfer to its Chinese partners.

GE made use of its reputation and relationships in China, as well as the favorable policy environment, to develop a successful business model for renewable energy in China. In doing so, it allowed its Chinese counterparts, such as the GE Technology Center, to play a major role in research and development.

V. CONCLUSION

Despite arguments from industrialized and developing countries that IPR are a barrier to technology transfer, the evidence shows that concerns over IPR are not a significant barrier to the transfer of renewable energy technology to China. The potential for growth in China’s renewable energy sector and the policy support for that growth, the relative insignificance of IP premiums as a factor in pricing, and the incentives for foreign firms to partner with Chinese firms provide foreign firms with enough expected return on its investment in technology transfer.

¹⁷⁶ *Id.*

¹⁷⁷ *Id.*

¹⁷⁸ Bullis, *supra* note 171.

¹⁷⁹ Press Release, Gen. Elec., GE Drivetrain Technologies and Chongqing XinXing Gear Finalize Joint Venture, Launch Gear Business for Wind Turbine Industry (Aug. 20, 2009), <http://www.genewscenter.com/content/Detail.aspx?ReleaseID=7643&NewsAreaID=2>.

¹⁸⁰ *Id.*

Even with high expected returns, technology transfer in the broader sense—encompassing the transfer of knowledge-based assets—would not occur if foreign firms felt that the risk in exposing their IP to a loosely regulated market was too high. The data presented in this paper, however, show that China's efforts to reform its IPR laws since the 1990s produced greater confidence among foreign firms in China's ability to protect their IPR. Indeed, the experiences of the three individual companies considered here—GT, Vestas, and GE—show that, at the very least, concerns over IPR do not have to be a significant barrier in technology transfer.

There are limitations to the discussion in this article, and issues for further investigation remain. First, this article relies on proxy evidence to support some of its conclusions, as some data that is specific to the renewable energy sector is difficult to obtain. For this reason, the author draws some conclusions with caution. Second, this article does not examine any normative hypotheses. The roles of China and other countries in international efforts to stop global climate change are subjects of debate, and this article investigates only whether concerns over IPR have been a barrier to technology transfer, not whether they should be. Finally, the relationship between IPR and technology transfer is not static, and this paper only investigates the relationship between IPR and technology transfer up to a point in time. Absorptive capacity is currently an issue for Chinese firms, but that capacity will increase as those firms develop their own technology and expertise in the coming years. China has made remarkably fast progress in several national-level indicators, such as its gross domestic product¹⁸¹ and share of its population above the poverty line,¹⁸² and there is no reason to believe that China must or will rely on foreign renewable energy technology forever. At the same time, it is possible that the quality of IPR protection will continue to improve enough to deter IP leakage in the renewable energy industry, or foreign and Chinese firms may become so

¹⁸¹ See, e.g., *World Development Indicators and Global Development Finance: China*, WORLD BANK (last visited July 24, 2012) [http://databank.worldbank.org/Data/Views/Reports/TableView.aspx?IsShare=1&IsPopular=country\(select "China"\)](http://databank.worldbank.org/Data/Views/Reports/TableView.aspx?IsShare=1&IsPopular=country(select%20%22China%22)).

¹⁸² See, e.g., *id.*; see also United Nations Statistics Division, Department of Economic and Social Affairs, *Millennium Development Goals Indicators*, UNITED NATIONS, <http://mdgs.un.org/unsd/mdg/data.aspx> (last visited Oct. 20, 2012) (select "China").

interdependent that their shared stakes in mutual success deter the theft of IP. Regardless of how the relationship between IPR and technology transfer in the renewable energy sector evolves, the global importance of renewable energy, especially in China, deserves continued attention.