# Making Transfer of Clean Technology Work: Lessons of the Clean Development Mechanism

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TABLE OF CONTENTS



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Establishing a framework to facilitate the transfer of clean technologies from developed countries to developing countries is one of the most challenging tasks that the international community has to tackle in order to prepare for the 2012 expiration of the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC).[1] The protocol aims to reduce emissions of greenhouse gases, including carbon dioxide,[2] to at least five percent below 1990 levels during the 2008–2012 commitment period.[3] To this end the protocol sets binding emissions targets for "Annex B" nations, a subset of nations listed under Annex I to the UNFCCC.[4]

Developing nations have reiterated that technology transfer is crucial to their efforts in reducing greenhouse gas emissions without compromising

1. United Nations Framework Convention on Climate Change, May 9, 1992, 1771 U.N.T.S. 107 (*entered into force* Mar. 21, 1994). Kyoto Protocol to the United Nations Framework Convention on Climate Change, Conference of the Parties, 3d Sess., U.N. Doc. FCCC/CP/1997/L.7/Add.1 (Dec. 11, 1997) [hereinafter Kyoto Protocol].

2. The six primary greenhouse gases are carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride ($SF_6$). Kyoto Protocol, *supra* note 1, Annex A.

3. Kyoto Protocol, *supra* note 1, art. 3(1).

4. "Annex B" nations refer to the United States and thirty-seven other industrialized countries, including fifteen members of the European Union. *See* Kyoto Protocol, *supra* note 1, Annex B, *available at* http://unfccc.int/kyoto_protocol/items/3145.php (listing countries included in Annex B to the Kyoto Protocol and their emissions targets). All "Annex B" nations but the United States have ratified the Protocol. *See* UNFCCC, Kyoto Protocol Status of Ratification, Jan. 14, 2009, *available at* http://unfccc.int/files/kyoto_protocol/status_of_ratification/application/pdf/kp_ratification_20090826corr.pdf.

their development needs. In the Bali Action Plan, which was adopted in 2007 to provide a roadmap for international negotiations on a post-Kyoto agreement, developing countries agree to take measurable, reportable, and verifiable actions regarding emissions, on the condition that developed countries offer assistance to them with measurable, reportable, and verifiable financing, technology, and capacity building. Developing countries warn that without advanced technologies their greenhouse gas emissions will remain unchanged for the next several decades.[5]

What post-Kyoto framework should be established to facilitate the transfer of clean technologies to developing countries? This difficult question is to be considered in December 2009 when parties to the UNFCCC convene in Copenhagen to design a successor treaty to the Kyoto Protocol. The question cannot be fully answered without a deep understanding of what actually drives such transfer. Several analyses of Clean Development Mechanism (CDM) projects have shed some light on the topic.[6] CDM is a market-based instrument under the Kyoto Protocol that allows industrialized countries with a greenhouse gas reduction commitment to invest in emissions reduction projects in the developing world.[7] Through these projects, these industrialized countries can earn emission credits, known as Certified Emission Reductions (CERs—a CER is defined as one metric ton of carbon dioxide equivalent ($tCO_2eq$)), to satisfy their reduction commitments or to sell them for profits. As an alternative to undertaking more expensive emission reduction projects at home, the CDM provides a financial incentive to motivate industrialized countries to participate in CDM projects. In order to increase their chance of getting approved to run these projects,

5. United Nations Framework Convention on Climate Change, Conference of the Parties, Thirteenth Session, Bali, Indon., Dec. 3–15, 2007, Decision 1/CP.13: Bali Action Plan, (1)(b)(i)–(ii), U.N. Doc. FCCC/CP/2007/6/Add.1 (Mar. 14, 2008), *available at* http://unfccc.int/resource/docs/2007/cop13/eng/06a01.pdf.

6. *See, e.g.*, Antoine Dechezleprête et al., *Technology Transfer by CDM Projects: A Comparison of Brazil, China, India and Mexico*, 37 ENERGY POLICY 703 (2009) [hereinafter Dechezleprête et al. 2009]; Antoine Dechezleprête et al., *The Clean Development Mechanism and the International Diffusion of Technologies: An Empirical Study*, 36 ENERGY POLICY 1273 (2008) [hereinafter Dechezleprête et al. 2008]; Stephen Seres, *Analysis of Technology Transfer in CDM Projects*, prepared for UNFCCC Registration & Issuance Unit CDM/SDM, Dec. 2008; H.C. De Coninck et al., *Technology Transfer in the Clean Development Mechanism*, ECN (Energy Res. Center of the Neth., Working Paper, ECNE–07–009, 2007), *available at* http:www.ecn.nl/docs/library/report/2007/e07009.pdf; Erik Haites et al., *Technology Transfer by CDM Projects*, 6 CLIMATE POLICY 327 (2006).

7. Kyoto Protocol, *supra* note 1, art. 12.

industrialized countries are often willing to transfer some of their clean technologies to developing countries even though most host countries do not adopt technology transfer as mandatory.[8]

Among published analyses of CDM projects, Dechezleprête et al.'s research stands out by offering an econometric analysis of 644 CDM projects registered as of May 2007 which study the international transfer of clean technologies induced by CDM projects in Brazil, China, India, and Mexico.[9] The study identifies the pattern of technology diffusion in these four major recipients of CDM projects. It finds, among other things, that the involvement of foreign partners in China's CDM projects is less frequent and that China's strong technological capabilities are positively correlated with the relatively high level of technology transfer to the country. Why do foreign companies participate less frequently in China's CDM projects? What contributes to China's "strong technological capabilities"? Dechezleprête et al.'s study does not address these and related issues.

This article takes a closer look at the case of China to fill the gap. It draws on numerous sources including Chinese laws and regulations, the country's policies on climate change, the country's technological capabilities and business environment, observations made by CDM specialists, and other studies of CDM projects. Such a comprehensive discussion, together with Dechezleprête et al.'s findings, will present a more complete picture of what actually drives the transfer of clean technologies to China and will, therefore, help design an effective post-Kyoto framework to facilitate international diffusion of clean technologies.

This article focuses on the case of China for two reasons. First, China is one of the largest emitters of greenhouse gases[10] and is a leading voice from the developing world to call for developed countries to uphold the UNFCCC's core principle of "common but differentiated responsibilities" by, among other things, providing financial support and transferring

8. For more discussion of how the adoption of technology transfer as a requirement in the CDM approval process affects the rate of CDM-related technology transfer, *see infra* Part II.F.2.a.

9. *See* Dechezleprête et al. 2009, *supra* note 6. In their article, the authors use the following terms interchangeably: "environmentally friendly technologies," "environmentally sound technologies," "GHG mitigation technologies," and "carbon mitigation technology." *Id*. In this article, all of these technologies are referred to as "clean technologies." For a detailed discussion of the differences between Dechezleprête et al.'s research and earlier studies, *see id.* § 1.

10. *See* Press Release, Neth. Envtl. Assessment Agency, China Now No. 1 in $CO_2$ Emissions, USA in Second Position (June 19, 2007) http://www.pbl.nl/en/news/pressreleases/2007/20070619Chinanowno1inCO2emissionsUSDinsecondposition.html; *China Overtakes U.S. in Greenhouse Gas Emissions*, INT'L HERALD TRIB., June 21, 2007. China disagreed. *See* Li Jing, *China Issues Post-Kyoto Plans*, CHINA DAILY, Oct. 30, 2008.

technologies to developing countries.[11] A post-Kyoto framework that is designed with comprehensive consideration of China's domestic situation for the transfer of clean technologies would significantly improve China's environment and thereby that of the world.

Second, the international community has centered the discussion of the post-Kyoto framework on reforms or even abolition of the current CDM. A critical issue in the overall assessment of CDM's contribution to sustainable development is CDM's contribution to the transfer of clean technologies to developing countries. As of September 25, 2009, China hosts the largest number of CDM projects registered with the United Nations and is the largest supplier of CERs. Of all 1,831 registered projects, China hosts 635 projects. The expected average annual reduction from China's registered projects is 188 million tons of carbon dioxide equivalents, which accounts for 59% of the expected average annual reduction from all registered projects. As of September 25, 2009, 333 million CERs have been issued, 46% of which are for projects hosted by China.[12] Given China's important role in the CDM, a better understanding of the CDM's contribution to the transfer of clean technologies to China is necessary for the full assessment of the value of the mechanism.

Part I of this article outlines Dechezleprête et al.'s findings concerning China. Building on these findings, Part II analyzes the drivers of CDM-related technology transfer to China. The article concludes by previewing those lessons that other developing countries and the international community could learn from China's experiences in order to create favorable international and domestic environments for the transfer of clean technologies.

## I. ECONOMETRIC ANALYSIS

Dechezleprête et al.'s research assesses technology transfer through the CDM by analyzing all 644 projects registered as of May 1, 2007. In 2008, the authors published their findings to answer such questions as

11. *See* Information Office of the State Council of the People's Republic of China, *China's Policies and Actions for Addressing Climate Change, Part III*, *at* 12 (Oct. 29, 2008) *available at* http://www.ccchina.gov.cn/WebSite/CCChina/UpFile/File419.pdf [hereinafter White Paper]; Cai Hong, *Nation Calls for Technology Transfer*, CHINA DAILY, Apr. 29, 2009.

12. *See* UNFCCC, CDM Statistics: Registration, http://cdm.unfccc.int/Statistics/Registration/NumOfRegisteredProjByHostParties PieChart.html (last visited Sept. 25, 2009).

"how often do CDM projects include a transfer of technology from abroad?," "in which sectors?," "which types of technologies are transferred?," "which countries are the main recipients?", and "who are the technology suppliers?"[13] That article also includes an econometric analysis of drivers of technology transfer through the CDM. The research finds, among other things, that the probability of technology transfer increases with the size of the projects and is 50% higher in projects implemented by a subsidiary of companies from Annex 1 nations. It also shows how host countries' technological capabilities could influence technology diffusion in the CDM.[14]

Using the same data and similar econometric models, Dechezleprête et al. published in early 2009 an article on technology transfer through the CDM in Brazil, China, India, and Mexico. By May 1, 2007, these four countries had gathered approximately 75% of all the CDM projects. The study finds that 59% of China CDM projects include international transfer of technology, compared with 12%, 40%, and 68% for India, Brazil, and Mexico, respectively.[15]

The econometric analysis included in the study has identified a few drivers of international technology transfer to China. Figure 1, adapted from a similar chart drawn by Dechezleprête et al., compares the impact of each variable on CDM-related technology transfer.[16] The findings relating to such variables as *GDP_GROWTH*, *TECH_CAPABILITY*, *PROJECT_SIZE*, *CREDIT_BUYER*, *SUBSIDIARY*, and *CHINA* are briefly described below. More in-depth discussions of these and other variables are presented in Part II.

1. *GDP_GROWTH*, which measures a host country's average annual rate of GDP growth: Investment opportunities generated by China's fast growing economy appear to be the decisive factor in the country's ability to attract CDM projects involving technology transfer.[17]
2. *TECH_CAPABILITY*, which indicates a host country's technological capabilities: China's strong technological capabilities are positively correlated with the country's relatively high level of technology transfer.[18]

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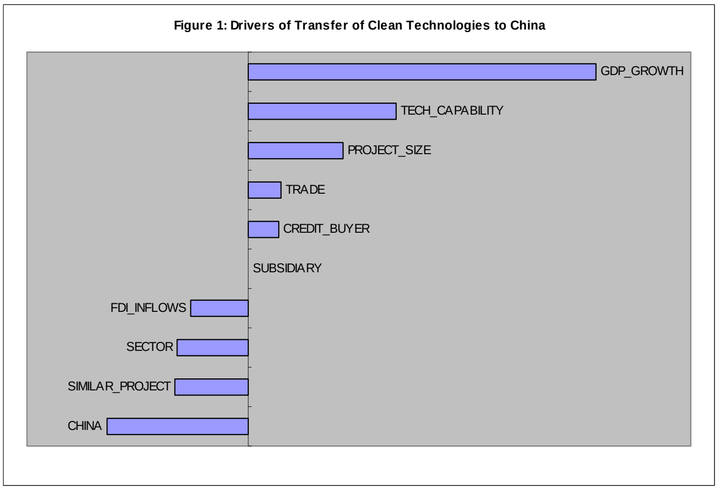
13. *See* Dechezleprête et al. 2008, *supra* note 6, at 1275–78.
14. *See id.* at 1278–82.
15. *See* Dechezleprête et al. 2009, *supra* note 6.
16. *See id.* at 709. Each bar in Figure 1 measures the impact of the variable on an average CDM project in China. Dechezleprête et al. do not provide in their article the values represented by these bars. This author measured the bars by computer software and reproduced Figure 1.
17. *See id.*
18. *See id.* at 710.

3. *PROJECT_SIZE*, which measures the log of the size of a CDM project (expected annual reductions in kt$CO_2$eq): Project size is found to have the third greatest positive impact on China CDM projects.[19]




4. *CREDIT_BUYER*, which indicates whether or not a CDM project has one or more buyers of emission credits: In the case of China, the involvement of foreign credit buyers in a CDM project favors technology transfer but the resulting impact on the likelihood of technology transfer is less than that from *GDP_GROWTH*, *TECH_CAPABILITY*, and *PROJECT_SIZE*.[20]
5. *SUBSIDIARY*, which indicates whether or not at least one developer of a CDM project is a host country-based subsidiary of a company from an Annex 1 nation: The involvement of China-based subsidiaries of companies from Annex 1 nations has no impact on the CDM-related technology transfer to China.[21]

19. *See id.* at 709.
20. *See id.*
21. *See id.*

6. *CHINA*, a country dummy that captures factors not taken into account by other country-level variables, namely, *GDP_GROWTH*, *TECH_CAPABILITY*, *TRADE*, *FDI_INFLOWS*: The econometric analysis shows that *CHINA* has significant negative impact on CDM-related technology transfer to China. Dechezleprête et al. conclude that factors captured by *CHINA* play a strong role in explaining country differences.[22]

Dechezleprête et al.'s econometric model correctly predicts 80% of the observations.[23] Although the model is reasonably good, it, as identified by the authors themselves, has several limitations. One limitation is that the authors rely on the description in the Project Design Documents (PDDs), which project developers must submit to the UN's CDM Executive Board during the approval process, to decide whether a CDM project involves technology transfer. For example, the import of goods (including generic devices such as DVD players) does not always involve technology transfer, but if the PDD claims that it does, the authors consider that there is technology transfer. As the existence of technology transfer helps project registration, project developers have incentives to erroneously make this claim in the PDDs. Because of this problem, descriptive statistics regarding technology transfer percentages may not be accurate. But, with respect to the econometric results, the authors opine that "one can realistically assume that this bias is randomly distributed over the PDD-writing population" and conclude that the problem "probably does not damage [the] econometric results."[24] The fact that the econometric model correctly predicts 80% of the observations seems to support this conclusion. Further, because technology transfer is not in most cases a prerequisite for an approved CDM project, the tendency for project developers to overstate the existence of technology transfer may not be damagingly high.

Another limitation is that Dechezleprête et al.'s study does not cover all forms of technology diffusion because the authors define the term "technology transfer" as the import of a technology from abroad, be it knowledge, equipment, or both.[25] This narrower definition, as the

22. *See id.* at 709–10.
23. *See* Dechezleprête et al. 2008, *supra* note 6, at 1280; Dechezleprête et al. 2009, *supra* note 6, at 708.
24. *See* Dechezleprête et al. 2009, *supra* note 6, at 705.
25. There is no single definition of technology transfer in international environmental law. The Intergovernmental Panel on Climate Change defines "technology transfer" as "a broad set of processes covering the flows of know-how, experience and equipment for mitigating and adapting to climate change amongst different stakeholders such as governments, private sector entities, financial institutions, non-governmental organizations and research/ education institutions." *See* IPCC Working Group III, *Intergovernmental Panel on*

authors point out, excludes intra-country technology transfers, such as those from urban areas to rural areas. The authors adopt a narrower definition because "intra-country transfers are difficult to track in PDDs, and therefore they do not lend themselves easily to statistical analysis."[26]

In addition to the problems identified by the authors themselves, two other limitations should be noted. First, Dechezleprête et al.'s study only analyzes all 644 CDM projects registered as of May 1, 2007. At the time of writing this article, the total number of registered CDM projects has more than doubled. Second, Dechezleprête et al. use the composite index developed by Archibugi and Coco (ArCo index) to determine a country's technological capabilities to import and use advanced technology. The Arco index, however, only covers years 1987–1990 and 1997–2000.[27] Many countries, including China, have advanced their technological capabilities since 2000. Thus, the reliance of the ArCo index may compromise the accuracy of Dechezleprête et al.'s findings.

To mitigate these limitations, this author draws on various sources to supplement Dechezleprête et al.'s findings. A good example is Seres's study.[28] In a report prepared for the UNFCCC, Seres analyzed the technology transfer claims in the PDDs of all 3,296 projects registered or proposed as of June 2008. The regression analysis used by Seres correctly classifies 80% of the observations.[29] This result is impressive, but, Seres's study arguably has its own limitation because approximately two-thirds of those 3,296 projects are in the pipeline, some of which may not be approved in the end. On countries' technological capabilities, more up-to-date data and relevant findings in the Seres's study will be used for comparison. Despite these efforts to mitigate the limitations, further research is warranted to enhance our understanding of CDM-related technology transfer. This author, therefore, identifies later in the article several areas that merit more research.

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*Climate Change Special Report, Methodological and Technological Issues in Technology Transfer*, at 3 (2000), *available at* http://www.ipcc.ch/pdf/specialreports/spm/srtt-en.pdf.

26. Dechezleprête et al. 2009, *supra* note 6, at 704.

27. *See* Daniele Archibugi & Alberto Coco, *A New Indicator of Technological Capabilities for Developed and Developing Countries (Arco)*, 32 WORLD DEVELOPMENT 629 (2004).

28. *See* Seres, *supra* note 6.

29. For a detailed explanation of Seres's regression analysis, see Seres, *supra* note 6, Annex A.

## II. DRIVERS OF TRANSFER OF CLEAN TECHNOLOGIES TO CHINA

### *A. GDP_GROWTH*

#### *1. Investment Opportunities Arising from Economic Growth*

According to Dechezleprête et al.'s econometric analysis, China's relatively high transfer rate of 59%, in comparison with the rates in India, Brazil, and Mexico, is mainly due to China's dynamic economy and its good technological capabilities.[30] The next section will discuss China's good technological capabilities. This section focuses on China's economic growth.

The important role played by China's fast growing economy in the country's ability to attract CDM projects involving technology transfer is consistent with the global trend. Dechezleprête et al. find that if a country's average GDP growth increases by one percentage point, the likeliness of technology transfer to that country rises by 19%.[31]

Since China launched its economic reform in the late 1970s, China has achieved annual average growth rates of 9.7%.[32] In 2007, China's GDP was $3.3 trillion, making China fall behind only the United States and Japan to become the third largest economy in the world.[33] Dechezleprête et al. attribute the important role of China's fast growing economy in CDM-related technology transfer to investment opportunities arising from the economic growth.[34] Indeed, because China offers companies located in its territory the second largest domestic and export market in the world, these companies can have extraordinary economies of scale and efficiency gains.[35] The enormous market size is the main reason for China's ability to become the 30th most competitive nation, while the other three BRIC economies—India (50th), Russia (51st), and Brazil (64th)—are ranked much lower.[36]

The CDM market and the clean technology market in China are particularly attractive. The global CDM market has increased to approximately $13 billion in 2007, a leap of more than 200% from

30. *See* Dechezleprête et al. 2009, *supra* note 6, at 710.
31. *See id.* at 709.
32. *See* World Economic Forum, *The Global Competitiveness Report 2008–09*, at 27, *available at* http://www.weforum.org/documents/gcr0809/index.html [hereinafter GCR].
33. *See* J.R. Wu, *China Overtakes Germany in GDP, Becomes Third-Largest Economy*, WALL ST. J. (N.Y.), Jan. 15, 2009, at A6.
34. *See* Dechezleprête et al. 2009, *supra* note 6, at 710.
35. *See* GCR, *supra* note 32, at 27. The United States offers the largest domestic and export market.
36. *See id*.

2006.[37] By 2012, there will likely be over 8,000 registered or proposed CDM projects, generating approximately 1.6 billion CERs. Assuming each carbon credit is worth $20, there will be more than $30 billion flowing into the developing world.[38] China is expected to supply approximately half of these credits.[39] This means that the China CDM market could be worth approximately $15 billion. With respect to China's clean technology market, the U.S. government has estimated it to be worth $186 billion in 2010 and $555 billion in 2020.[40] Since 2000, venture capitalists around the world have invested $10 billion in clean technology, but less than 10% of this amount has been invested in China's clean technology companies.[41] In fact, in 2008 clean technology companies in China were able to raise only $430 million.[42] All of this means that much of the CDM and clean technology markets in China remains untapped. It is, therefore, not surprising that companies of clean technologies from developed countries are attracted to transfer some of their technologies through CDM projects in exchange for more opportunities in China's CDM and clean technology markets.

### *2. Policy and Regulatory Framework*

China's attractive CDM and clean technology markets are results of the country's policies, laws, and regulations that set ambitious energy efficiency and emissions targets. An overview of a few major policies, laws, and regulations in this area is illustrative.

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37. *See* Karen Capoor & Philippe Ambrosi, The World Bank, State and Trends of the Carbon Market, at 19 (2008), http://www.wds.woldbank.org/external/default/WDSContentServer/WDSP/IB/2008/07/08/000333037_20080708060533/Rendered/PDF/446070AR 0BOX321carbon0200801PUBLIC1.pdf.

38. *See Numbers of Projects World-Wide Registered or in Pipeline at Over 4,000 Up From 60 in 2004 Says UNEP*, STATES NEWS SERVICE, Dec. 11, 2008.

39. *See* Othmar Schwank & Madeleine Guyer, *CDM IN CHINA: Contribution to National and International Goals of Climate Policy* (INFRAS, Research and Consulting, Conference Paper CH8045 Zurich, 2009), http://www.nccr-climate.unibe.ch/conferences/climate_policies/working_papers/Schwank.pdf.

40. *See* U.S. DEPARTMENT OF COMMERCE, CLEAN ENERGY: AN EXPORTER'S GUIDE TO CHINA, at 3 (2008), http://trade.gov/media/publications/ pdf/china-clean-energy2008.pdf [hereinafter U.S. Dep't of Commerce].

41. *See* Gary Rieschel, *Clean Technologies Alluring to Venture Capital*, CHINA DAILY, Nov. 10, 2008.

42. *See Clean Technology Venture Investment Reaches Record $8.4 Billion in 2008 Despite Credit Crisis and Broadening Recession; Even With Diminished 4Q08 Results, Clean Technology Investment Fundamentals Remain Strong*, BUSINESS WIRE, Jan. 6, 2009.

In the *Outline of the Eleventh Five-Year Plan for National Economic and Social Development of the People's Republic of China (2006–2010)*, China sets the goal to build a resource efficient and environmentally friendly society.[43] A specific benchmark identified by the government is that the country has to reduce the energy consumption per unit of GDP by 20% by the year 2010 compared to that in 2005.[44] To help local regions meet this benchmark, the central government sets targets for every region. For example, Jilin province has to reduce its energy consumption per unit of GDP by 30%; Shanxi and Inner Mongolia by 25%; Shandong by 22%; Yunnan and Qinghai by 17%; Fujian and Guangdong by 16%; Guangxi by 15%; Hainan and Tibet by 12%; and other provinces by 20%.[45]

In June 2007 China adopted the *National Climate Change Program*, the country's first plan on climate change.[46] The program clearly states that the climate change issue shall be addressed through the advancement and innovation of science and technology, and that strengthening the development and dissemination of advanced and suitable technologies is a major initiative.[47] To give support to the program and to coordinate climate change-related scientific research and technological development, fourteen ministries and commissions jointly formulated the *China's Scientific & Technological Actions on Climate Change*.[48] Details about these actions will be discussed later in this article.

China has established quite an impressive legislative framework to regulate climate change and environmental protection issues. The *Measures for Operation and Management of Clean Development Mechanism Projects* (Measures), which the rest of the article frequently refers to,

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43. The Outline of the Eleventh Five-Year Plan for National Economic and Social Development (2006–10), adopted by the National People's Congress in Mar. 2006, ch. 6 (China), http://en.ndrc.gov.cn/hot/t2006052971334.htm [hereinafter Eleventh Five-Year Plan]. For a mid-term evaluation of these goals, see The World Bank, *Mid-term Evaluation of China's 11th Five Year Plan*, at 111–29 (Dec. 18, 2008), *available at* http://siteresources.worldbank.org/CHINAEXTN/Resources/318949-1121421890573/China 11th_Five_Year_Plan_main_report_en.pdf [hereinafter Mid-term Evaluation].

44. *See* Eleventh Five-Year Plan, *supra* note 43, at ch. 1.

45. *See* Mid-term Evaluation, *supra* note 43, ¶ 4.8.

46. *See* National Development and Reform Commission, *China's National Climate Change Program* (June 2007), *available at* http://www.ccchina.gov.cn/WebSite/CCChina/ UpFile/File188.pdf.

47. *See id.* at 25, 35.

48. *See* China's Scientific & Technological Actions on Climate Change, jointly issued by the Ministry of Science and Technology, the National Development and Reform Commission, the Ministry of Foreign Affairs, the Ministry of Education, the Ministry of Finance, the Ministry of Water Resources, the Ministry of Agriculture, the State Environmental Protection Administration, the State Forestry Administration, the Chinese Academy of Sciences, the China Meteorology Administration, the National Natural Science Foundation, the State Oceanic Administration, and the China Association for Science and Technology (2007), http://www.ccchina.gov.cn.WebSite/CCChina/UpFile/File199.pdf (P.R.C.).

was promulgated in October 2005 to implement the CDM.[49] A few major laws adopted or amended in recent years are noteworthy.

First, the *Law on the Promotion of Clean Production* requires that "any units or individuals engaged in activities relating to production or provision of services and their corresponding management agencies" must implement systems for cleaner production in accordance with the law.[50] "Cleaner production" refers to, among other things, the utilization of clean energy sources, low-pollution technologies and production methods, and improved environmental management.[51] To help implement the law, the State Council periodically issues a directory of production processes, technologies, equipment, and products that must be eliminated within a fixed time limit.[52] Any enterprise or individual who violates this law may be ordered to make rectifications or be fined.[53] Serious violations may also lead to criminal liability.[54]

Second, the *Renewable Energy Law* promotes the development and utilization of renewable energy, including non-fossil energy such as wind energy, solar energy, water energy, biomass energy, geothermal energy, and ocean energy.[55] It gives priority to renewable energy when transmitted on the state power grid and offers users of renewable energy price discounts.[56] To foster renewable energy development, the law creates a national fund to support various initiatives including scientific and technological research on renewable energy, as well as construction of renewable energy projects.[57] It also authorizes financial institutions to

49. Measures for Operation and Management of Clean Development Mechanism Projects (promulgated by the National Development and Reform Commission, the Ministry of Science and Technology, the Ministry of Foreign Affairs and the Ministry of Finance, effective Oct. 12, 2005), LAWINFOCHINA, translated at http://cdm.ccchina.gov.cn/english/NewsInfo.asp?NewsId=905 [hereinafter Measures]. The Measures replaced the Interim Measures for Operation and Management of Clean Development Mechanism Projects issued on May 31, 2004.

50. Law on the Promotion of Clean Production (promulgated by the Standing Comm. Nat'l People's Cong., June 29, 2002, effective Jan. 1, 2003), LAWINFOCHINA, art. 3, translated at http://www.lawinfochina.com/law/display.asp?db=1&id=2388&keyword=clean%20production.

51. *Id.* art. 2.

52. *Id.* art. 12.

53. *Id.* arts. 37–41.

54. *Id.*

55. Renewable Energy Law (promulgated by the Standing Comm. Nat'l People's Cong., Feb. 28, 2005, effective Jan. 1, 2006), arts. 1 and 2, translated at http://www.martinot.info/China_RE_Law_Beijing_Review.pdf.

56. *Id.* arts. 13–23.

57. *Id.* art. 24.

offer favorable loan conditions to renewable energy projects.[58] To help implement the law, the *Mid- and Long-Term Renewable Energy Development Plan* was issued to quantify policy targets for key renewable energy technologies.[59]

Third, the *Energy Conservation Law*,[60] built on the 1997 Energy Conservation Law, aims to "promote[] energy conservation in the whole society" and "enhance[] energy utilization efficiency.[61] The revised law bans the use of energy-intensive equipment,[62] prescribes special requirements for construction projects,[63] requires public institutions to take the lead using energy-saving products and equipment,[64] and provides tax incentives for companies using energy-saving technologies and products.[65]

Fourth, the *Circular Economy Promotion Law* aims to promote the development of the "circular economy," which is defined as a generic term for the reduction, reuse, and recycling activities in the course of production, circulation, and consumption.[66] The law, for example, requires enterprises that produce products or packages listed on the catalogue of mandatory recycling to recycle the materials. If recycling is not possible due to technological or economic restrictions, the enterprise must dispose of the materials in non-harmful ways.[67] The law also requires enterprises in industries such as the electric power, petroleum processing, and building materials industries to use clean energy by the time limit set by the state.[68] The law authorizes tax preferences granted to industrial activities that promote the development of the circular economy.[69]

These policies, laws, and regulations are quite impressive. But if they are not properly implemented to meet the prescribed targets, the actual

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58. *Id.* art. 25.

59. For a summary of these objectives, *see* U.S. Dep't of Commerce, *supra* note 40, at Tbl. A.

60. Energy Conservation Law (promulgated by the Standing Comm. Nat'l People's Cong., Oct. 28, 2007, effective Apr. 1, 2008), LAWINFOCHINA, translated at http://www.lawinfochina.com/law/display.asp?db=1&id=6467&keyword=energy%20conservation%20law.

61. *Id.* art. 1.

62. *Id.* arts. 16–17, 51.

63. *Id.* arts. 34–40.

64. *Id.* arts. 47–51.

65. *Id.* arts. 60–67.

66. Circular Economy Promotion Law (promulgated by the Standing Comm. Nat'l People's Cong., Aug. 29, 2008, effective Jan. 1, 2009), LAWINFOCHINA, arts. 1, 2, translated at http://www.lawinfochina.com/law/display.asp?db=1&id=7025&keyword=Circular%20Economy%20Promotion%20Law.

67. *Id.* art. 15.

68. *Id.* art. 21.

69. *Id.* art. 44.

sizes of China's CDM and clean technology markets will not be as attractive as speculated. According to the World Bank's mid-term evaluation of China's implementation of the Eleventh Five-Year Plan, the country's progress on the environmental objectives has been mixed. China has made insufficient progress in reducing energy intensity mainly because the efficiency gains from technical advancement and closure of inefficient capacity are still limited. Further, capital-intensive and high-energy-using industries continue to outgrow other parts of the economy. On building a more resource efficient and environmentally sound economy, China has made some, but not significant, improvements in reducing air and water pollution, increasing water use efficiency, treating industrial solid waste, and expanding forest coverage. The World Bank has called for various remedial measures, including better enforcement of regulatory standards in this area.[70]

To help implement the abovementioned polices, laws, and regulations by promoting more investment in clean technologies, China's central government issued the *Foreign Investment Industrial Guidance Catalogue (2007 Amendment)* (2007 Catalogue).[71] A major policy objective of this Catalogue is to promote resource conservation and environmental protection by restricting or prohibiting FDI in high-pollution and high-energy-consumption projects and by encouraging FDI in environmental and energy-saving technologies.

The 2007 Catalogue explicitly identifies three groups of industrial sectors, namely, "encouraged" (e.g. the production of environmentally friendly chemical fibers such as cellulose fibers using new solvent methods), "restricted" (e.g. the exploration for, and mining of, special and scarce coals), or "prohibited" (e.g. the establishment and operation of nature preserves and internationally important wetlands). Any industrial sector that is not specifically identified falls by default into the "permitted"

70. *See* Mid-term Evaluation, *supra* note 43, ¶¶ 12, 23, 27, 28, 39 of the Executive Summary and chs. 4, 7.

71. Foreign Investment Industrial Guidance Catalogue (2007 Amendment) (promulgated by the State Dev. and Reform Comm'n and the Ministry of Commerce of the P.R.C., Oct. 31, 2007, effective Dec. 1, 2007), LAWINFOCHINA, translated at http://www.lawinfochina.com/law/display.asp?db=1&id=6483&keyword=foreign%20investment. For a discussion of the 2007 Catalogue, *see* Thomas Y. Man et al., *Foreign Investment Industry Catalogue: New Revisions & Alignment with National Development Strategy*, CHINA L. & PRAC., Dec. 2007/Jan. 2008; Paul McKenzie, *China's Updated Foreign Investment Industrial Guidance Catalog—Encouraging Clean Tech in the Middle Kingdom*, *in* China Clean Tech Bulletin—Feb. 2008, *reprinted in* MONDAQ BUSINESS BRIEFING, Mar. 3, 2008.

category. Foreign investors are banned from investing in "prohibited" industries. But they can invest in "restricted," "permitted," and "encouraged" (arranged in decreasing order of restrictions) projects so long as they obtain the appropriate level of government approval and comply with applicable restrictions on foreign ownership. Since the issuance of the 2007 Catalogue, China's Ministry of Commerce has made a major shift in the foreign investment approval policy by delegating much of its power in this area to lower level authorities. As a result, most foreign investment projects can now be approved at the local level. This is generally welcome because obtaining an approval from the Ministry of Commerce could be burdensome and time consuming.[72]

The exact impact of the 2007 Catalogue and the Ministry of Commerce's delegation of approving authority on the investment in clean technologies remains unclear. But the impact is expected to be generally positive, even though the magnitude may have been reduced because of the global financial crisis. To minimize the negative impact of the crisis on foreign investment, the Chinese central government has decided to spend $142 billion of its $570 billion stimulus package in the next three years on environmental improvements.[73] These steps, together with China's ability to do much better than most other countries during the current crisis,[74] suggest that China will likely continue to provide attractive investment opportunities for companies of clean technologies.

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72. The Ministry of Commerce has issued several circulars to delegate its power. *See* Notice on Further Enhancement of the Approval Scheme for Foreign Investment (promulgated by the Ministry of Commerce of the P.R.C., effective Mar. 5, 2009); Notice on Delegation of the Approval Authority on Establishment of Foreign Invested Holding Companies (promulgated by the Ministry of Commerce of the P.R.C., effective Mar. 6, 2009); Notice on Further Simplifying and Regulating the Foreign Investment Administration (promulgated by the Ministry of Commerce of the P.R.C., effective Aug. 26, 2008); Notice on the Delegation of Approval on the Alteration of Foreign Invested Joint Stock Companies and Foreign invested Enterprises (promulgated by the Ministry of Commerce of the P.R.C., effective Aug. 11, 2008); Notice on the Delegation of Approval Authority on Foreign Invested Commercial Enterprises (promulgated by the Ministry of Commerce of the P.R.C., effective Sept. 12, 2008); Notice on the Approval Matters relating to the Foreign Invested Venture Capital Enterprises and Foreign Invested Venture Capital Administration Enterprises (promulgated by the Ministry of Commerce of the P.R.C., effective Mar. 5, 2009). *See* Jonathan Zhou et al., *Handing Down Authority for Foreign Investment*, CHINA L. & PRAC., Apr. 2009, at 20; Charles Comey et al., *MOFCOM Further Delegates Foreign Investment Approval Authority*, Apr. 2009, http://www.mofo.com/international/CN_en/news/15423.html.

73. *See* Achim Steiner, *Reflections*, *in* OUR PLANET (United Nations Env't Programme), Feb. 2009, at 3. For a list of measures that China's State Council has issued to boost the economy, *see* Several Opinions of the General Office of the State Council on Providing Financial Support for Economic Development (promulgated by the General Office of the State Council, effective Dec. 8, 2008).

74. *See* World Bank, China Quarterly Update (Mar. 18, 2009), http://www.worldbank.org/china. The World Bank analyzes that China can do much better than most other countries during the financial crisis because the country "does not rely on

### *3. Climate Change Perceived As An Economic Development Issue*

All of the above policies, laws, and regulations in China underscore its central government's emphasis on energy efficiency and environmental protection, and the use of clean technologies to tackle these problems. Although the U.N. Development Program has recommended in the *2007/2008 Human Development Report, Fighting Climate Change: Human Solidarity in a Divided World* that "[m]ajor emitters in developing countries. . . aim at an emissions trajectory that peaks in 2020, with 20 percent cuts by 2050,"[75] China is not bound to do so. Why has China been so proactive in setting a wide range of climate change related goals, some of which exceed even efforts in the developed world?

A major underlying reason is that the Chinese central government perceives economic development, China's ultimate goal since it adopted the opening-up policy in the late 1970s, as the "core objective" of dealing with the climate change issue. In the white paper titled *China's Policies and Actions for Addressing Climate Change*, the Chinese central government explicitly states:

> *Taking economic development as the core objective*, and placing emphasis on energy conservation, optimization of the energy mix, reinforcement of ecological protection and construction, and scientific and technological progress as backup, *China strives to control and mitigate the emission of greenhouse gases and continuously enhance the capability of adapting itself to climate change*. (emphasis added)[76]

Such perception is reflected in the institutional structure for handling climate change issues in general and CDM projects in particular.

Since the late 1990s, China's climate change policy has been mainly overseen by the central government's National Development and Reform Commission (NDRC),[77] a powerful government agency whose primary task is to advance the country's economic development. Before that the responsibility was in the jurisdiction of China's State Meteorological Administration. This institutional change strongly signaled that climate

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external financing and its banks remain generally unscathed by the international financial turmoil" and because "[China] has the fiscal and macroeconomic space to implement forceful stimulus measures." *Id.*

75. *See* United Nations Development Programme, *2007/2008 Human Development Report*: *Fighting Climate Change: Human Solidarity in a Divided World*, at 17, *available at* http://hdr.undp.org/en/media/HDR_20072008_EN_Complete.pdf.

76. *See* White Paper, *supra* note 11, at Foreword.

77. The National Development and Reform Commission was formerly named the State Development and Planning Commission.

change had shifted from being a scientific issue to an economic development issue.[78]

The subsequent establishment of high-level groups on climate change shows that Chinese leaders see the significant impact of climate change on the nation's economic development and find it necessary to have senior officials hold the helm. The first group was announced when the National Climate Change Program was released. This group is chaired by Premier Wen Jiabao and reports directly to the State Council. The second group is headed by Foreign Minister Yang Jiechi and is responsible for international work on climate change.[79]

With respect to the CDM program, several governmental agencies and authorities are involved in the approval, registration, and management of CDM projects.[80] The National Coordination Committee on Climate Change (NCCCC) reviews and coordinates China's national CDM policies and rules.[81] Established under the NCCCC is the National CDM Board (the Board).[82] The NDRC and the Ministry of Science and Technology are co-chairs of the Board, whereas the Ministry of Foreign Affairs is the vice chair. Other board members include the Ministry of Environmental Protection,[83] the China Meteorological Administration, the Ministry of Finance, and the Ministry of Agriculture.[84] The Board, as explained in Part II.C., plays important roles, which include conducting reviews of CDM applications, CER prices, and CDM project activities.

Apart from its role in the Board, the NDRC is also China's Designated National Authority for CDM. In this capacity, the NDRC acts as the key interface between the authorities and project participants. Specifically, it accepts CDM project applications and approves CDM project activities jointly with the Ministry of Science and Technology and the Ministry of Foreign Affairs on the basis of the conclusion made by the Board. It

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78. *See* Joanna I. Lewis, *China's Strategic Priorities in International Climate Change Negotiations*, 31 WASH. QUARTERLY 155, 158 (Winter 2007–08), http://www.twq.com/08winter/docs/08winter_lewis.pdf. *See also* Tseming Yang, *The Implementation Challenge of Mitigating China's Greenhouse Gas Emissions*, 20 GEO. INT'L ENVTL L. REV. 681, 687–88 (2008).

79. *See Chinese Foreign Ministry Sets Up Climate Change Int'l Working Group*, XINHUA NEWS AGENCY, Sept. 5, 2007, *cited in* Lewis, *supra* note 78, at 159, *available at* http://news.xinhuanet.com/english/2007-09/05/content_6667432.htm.

80. For detailed discussion of China's CDM approval process, *see infra* Part II.C.

81. Measures, *supra* note 49, art. 14.

82. *Id.* art. 13

83. During China's recent restructuring of its central government, the State Environmental Protection Administration, China's equivalent to the U.S. Environmental Protection Agency, was granted full cabinet status to become the Ministry of the Environmental Protection. *See Highlights of China's Institutional Restructuring Plan*, XINHUA NEWS AGENCY, Mar. 15, 2008, *available at* http://news.xinhuanet.com/english/2008-03/15/content_7797293.htm.

84. Measures, *supra* note 49, art. 15.

also issues an approval letter for the application and supervises the implementation of CDM project activities.[85] This institutional structure of China's CDM program again shows the prominent role of the NDRC and reflects Chinese leaders' perception of climate change as an economic development issue.

The direct link between climate change and economic development is further emphasized in a white paper titled *China's Actions for Disaster Prevention and Reduction* released by China's State Council in May 2009.[86] The report summarizes that every year from 1990 to 2008, natural disasters on average affected about 300 million people and resulted in direct financial losses of more than RMB200 billion. The report concludes that "now and for a fairly long time to come, the risks of extreme weather phenomena are increasing along with global climate changes" and sets forth a few measures, including advancement of scientific and technological support capability, to cope with the challenges.[87]

The enormous economic loss that could be caused by climate change and the threat to the power of the ruling Chinese Communist Party if it fails to meet its people's demand for a cleaner and safer environment leave the Chinese leaders with no option other than acting proactively in setting a wide range of climate change related goals. These concerns also explain the central government's continued efforts, as described above, in promoting investment in clean technologies during the global financial crisis.

## *B. TECH_CAPABILITY*

### *1. "Strong Technological Capabilities"*

Dechezleprête et al. find that China's strong technological capabilities are positively correlated with the country's relatively high level of technology transfer. The authors rely on the ArCo technology index to conclude that China has "[s]trong technological capabilities."[88] The ArCo index captures three aspects to determine a country's technological capabilities: (a) the creation of technology (number of patents and number of scientific articles); (b) the technological infrastructures (internet

85. *Id*. art. 16.
86. *See "Full Text" of China's White Paper on Disaster Prevention*, BBC MONITORING ASIA PACIFIC—POLITICAL, May 12, 2009.
87. *See id*.
88. *See* Dechezleprête et al. 2009, *supra* note 6, at 710.

penetration, telephone penetration and electricity consumption); and (c) the development of human skills (percentage of tertiary science and engineering enrollment, mean years of schooling and literacy rate).[89] As mentioned in Part I, the ArCo index does not cover developments after the year 2000. It is, therefore, helpful to refer to more up-to-date data to decide whether or not China does have "[s]trong technological capabilities."

The Global Competitiveness Index (GCI) 2008–2009 sheds some light on China's technological capabilities. One of the twelve pillars of competitiveness is technological innovation, which captures seven items:

a. capacity for innovation (25/134),[90]
b. quality of scientific research institutions (37/134),[91]
c. company spending on R&D (24/134),[92]
d. university-industry research collaboration (23/134),[93]
e. government procurement of advanced technology products (20/134),[94]
f. availability of scientists and engineers (52/134),[95] and
g. patents for invention (54/134).[96]

Overall, China's "technological innovation" is ranked 28th among the 134 economies included in the study.[97] The individual ranking of each of the seven items is included in the brackets. For example, China's "capacity for innovation" is ranked 25th among the 134 economies.[98] China's "technological innovation" is the third most significant factor in making China become the 30th most competitive nation in the world.[99] The two most significant factors are China's market size (2/134) and macroeconomic stability (11/134).[100]

The more up-to-date GCI Index does, therefore, give support to Dechezleprête et al.'s finding that China has "strong technological capabilities." One may argue that if China has "strong technological capabilities," China has enough technologies and does not need to rely on international transfer of clean technologies. In other words, Dechezleprête et al.'s conclusion that China's "strong technological capabilities" are

89. *See id.* at 708.
90. *See* GCR, *supra* note 32, at 486.
91. *See id.* at 487.
92. *See id.* at 488.
93. *See id.* at 489.
94. *See id.* at 490.
95. *See id.* at 491.
96. *See id.* at 492.
97. *See id.* at 134–35.
98. *See id.* at 486.
99. *See id.* at 134–35.
100. *See id.*

*positively* correlated with the country's relatively high level of technology transfers sounds incorrect. The correlation should be negative.

This argument is flawed because Dechezleprête et al.'s conclusion about China is made after taking into account the "two antagonistic effects of technological capabilities."[101] According to Dechezleprête et al., on the one hand, a country's technological capability favors international technology transfer because this means that local implementers have the skills to use the transferred technologies for their CDM projects. On the other hand, high technological capabilities may imply that the technologies required for the CDM projects are available locally. To find out the net result of these two effects, Dechezleprête et al. add another variable, *SIMILAR_PROJECT*, to measure the number of other CDM projects that use the same technology within the host country. The more similar projects a host country has, the less likely international technology transfer takes place.[102]

Dechezleprête et al.'s econometric analysis shows that the mitigating effect of *SIMILAR_PROJECT* is the strongest in the case of India, compared with the other countries of China, Brazil, and Mexico. As a result, the net effect of technological capabilities in promoting technology transfer is the lowest in India. The authors find that India has been particularly successful in employing its technology capabilities to diffuse clean technologies acquired through the CDM within the nation. Once these technologies are available locally, the need for having them transferred internationally is lowered. The authors conclude that this is the main reason for India's lower rate of international technology transfer (12%), compared with that in Brazil (40%), China (59%), and Mexico (68%).[103]

Seres sheds more light on the impact of similar projects in a host country. In his regression analysis of all 3,296 CDM projects registered or proposed as of June 2008, Seres, like Dechezleprête et al., includes a variable to measure the number of previous CDM projects of the same type in a host country. The variable is found to have significant impact on the trends of technology transfer to the host countries. He finds that China has shown an overall downward trend from having a relatively high technology transfer rate of 55% for the first 854 projects to 16% for

101. *See* Dechezleprête et al. 2008, *supra* note 6, at 1281.
102. *See* Dechezleprête et al. 2009, *supra* note 6, at 708.
103. *See id.* at 710.

the last 1,003 projects (see Table A). This indicates that technologies transferred in earlier CDM projects are diffused locally and thus later projects of similar types can rely more on local knowledge and equipment.[104]

TABLE A

| PERCENTAGE OF CDM PROJECTS IN CHINA WITH TECHNOLOGY TRANSFER (TT) | | | |
|---|---|---|---|
| Project Number* | 1–854 | 855–2,293 | 2,294–3,296 |
| % of Projects with TT | 55 | 34 | 16 |
| % of Annual Reductions with TT | 77 | 66 | 30 |
| * Project number is based on the date when the project entered the pipeline. | | | |

Seres also finds that China has evolved to be a source of clean technologies. This is likely the combined result of both China's gradual improvement in its innovation and the diffusion of technologies transferred to China through earlier CDM projects or other investments. Table B, tabulated in accordance with data reported in Seres's study, shows the sources of technology transferred through CDM projects. Each source of technology transfer is credited with the estimated annual emission reductions of the project.[105] Seres identifies three types of CDM projects involving technology transfer: transfer of equipment, transfer of knowledge, and transfer of both equipment and knowledge. Some projects involving technology transfer do not specify the sources. When these projects are excluded from calculations, 93% of the equipment and 99% of the knowledge transfer come from Annex I parties (see Table B). Among the sources other than Annex I parties, Brazil, China, India, Malaysia, South Korea, and Taiwan are found to be the most

104. *See* Seres, *supra* note 6, § 13, at 15–16. Seres does not discuss how these technologies are diffused locally. Nor does he suggest whether host countries' inadequate protection of intellectual property rights may have expedited such technology diffusion. See *infra* Part II.F.2.c. for a discussion of inadequate protection of intellectual property rights.

105. *See* Seres, *supra* note 6, § 9, at 11.

important sources. Interestingly, China's new role of being a source of clean technologies has also captured the attention of the New York Times, whose coverage of China is usually critical. According to the newspaper, China has emerged over the past two years to be a leading builder of more efficient and less polluting coal power plants, and has been building one plant of this type per month, on average.[106]

While China's evolution to be a source of clean technologies is encouraging, one must note that it only contributes 0.32% of all the transfers of equipment and 0.07% of all the transfers of knowledge (see Table B). This suggests that in spite of its improvement in technological innovation and its ability to diffuse some technologies acquired through earlier CDM projects, China does not have many technologies that can be transferred. In fact, one pillar of the GCI 2008–2009 is "technological readiness," which captures such items as availability of latest technologies (83/134).[107] Overall, China's "technological readiness" is ranked 77th among the 134 economies, lagging behind other BRIC countries, namely: Brazil (56th), Russia (67th), and India (69th).[108] Interestingly, in terms of "technological innovation," China (28th) leads Brazil (43rd), Russia (48th), and India (32nd).[109] China's different positions in "technological innovation" and "technological readiness" among the BRIC countries indicate that although China's efforts in improving the country's innovation are impressive and will benefit the country in the long run, these efforts have not immediately turned the country into one with ready access to the latest technologies. Other BRIC countries that have not accomplished as much as China in improving their own "technological innovation" may still improve their short-term competitiveness by adopting existing technologies elsewhere.

106. *See* Keith Bradsher, *China Far Outpaces U.S. in Building Cleaner Coal-Fired Plants*, N.Y. TIMES, May 11, 2009, at A1. China has developed the capacity to manufacture supercritical boilers, a key component of these coal power plants. I thank Michael Wara, Assistant Professor of Stanford Law School, for sharing this comment.
107. *See* GCR, *supra* note 32, at 460.
108. *See id.* at 114, 134, 188, 288.
109. *See id.*

## TABLE B

SOURCES OF TECHNOLOGY TRANSFERS ($KTCO_2$/YEAR). THIS TABLE IS TABULATED IN ACCORDANCE WITH DATA REPORTED IN SERES'S STUDY

| | Transfer of | | | | Total | | | |
|---|---|---|---|---|---|---|---|---|
| | Equipment only (Column A) | Knowledge only (Column B) | Equipment & Knowledge: Equipment (Column C) | Equipment & Knowledge: Knowledge (Column D) | Equipment (= A + C) | % of total | Knowledge (= B + D) | % of total |
| **Annex 1 party** | | | | | | | | |
| Australia | 323.00 | 0.00 | 348.00 | 422.00 | 671.00 | 0.40 | 422.00 | 0.34 |
| Austria | 2,613.00 | 0.00 | 1,211.00 | 1,189.00 | 3,824.00 | 2.26 | 1,189.00 | 0.95 |
| Belgium | 1,259.00 | 61.00 | 853.00 | 572.00 | 2,112.00 | 1.25 | 633.00 | 0.51 |
| Canada | 0.00 | 19.00 | 4,833.00 | 8,023.00 | 4,833.00 | 2.86 | 8,042.00 | 6.44 |
| Czech Republic | 50.00 | 0.00 | 0.00 | 0.00 | 50.00 | 0.03 | 0.00 | 0.00 |
| Denmark | 2,838.00 | 130.00 | 4,190.00 | 5,869.00 | 7,028.00 | 4.16 | 5,999.00 | 4.81 |
| Europe | 1,907.00 | 65.00 | 1,699.00 | 1,515.00 | 3,606.00 | 2.13 | 1,580.00 | 1.27 |
| Finland | 6.00 | 347.00 | 130.00 | 139.00 | 136.00 | 0.08 | 486.00 | 0.39 |
| France | 236.00 | 574.00 | 14,668.00 | 19,046.00 | 14,904.00 | 8.82 | 19,620.00 | 15.72 |
| Germany | 8,027.00 | 15,780.00 | 16,350.00 | 15,873.00 | 24,377.00 | 14.43 | 31,653.00 | 25.36 |
| Iceland | 0.00 | 0.00 | 37.00 | 37.00 | 37.00 | 0.02 | 37.00 | 0.03 |
| Italy | 0.00 | 600.00 | 1,503.00 | 2,359.00 | 1,503.00 | 0.89 | 2,959.00 | 2.37 |
| Japan | 27,025.00 | 1,262.00 | 17,125.00 | 17,193.00 | 44,150.00 | 26.13 | 18,455.00 | 14.78 |
| Luxembourg | 0.00 | 0.00 | 3,050.00 | 2,288.00 | 3,050.00 | 1.81 | 2,288.00 | 1.83 |
| Netherlands | 52.00 | 1,404.00 | 3,462.00 | 3,071.00 | 3,514.00 | 2.08 | 4,475.00 | 3.58 |
| New Zealand | 0.00 | 0.00 | 169.00 | 1,559.00 | 169.00 | 0.10 | 1,559.00 | 1.25 |
| Norway | 13.00 | 0.00 | 351.00 | 351.00 | 364.00 | 0.22 | 351.00 | 0.28 |
| Poland | 0.00 | 0.00 | 67.00 | 51.00 | 67.00 | 0.04 | 51.00 | 0.04 |
| Romania | 26.00 | 0.00 | 0.00 | 0.00 | 26.00 | 0.02 | 0.00 | 0.00 |
| Russia | 478.00 | 136.00 | 0.00 | 0.00 | 478.00 | 0.28 | 136.00 | 0.11 |
| Slovenia | 0.00 | 0.00 | 67.00 | 51.00 | 67.00 | 0.04 | 51.00 | 0.04 |
| Spain | 1,975.00 | 132.00 | 2,210.00 | 2,106.00 | 4,185.00 | 2.48 | 2,238.00 | 1.79 |
| Sweden | 199.00 | 0.00 | 2,155.00 | 282.00 | 2,354.00 | 1.39 | 282.00 | 0.23 |
| Switzerland | 13.00 | 1,150.00 | 258.00 | 794.00 | 271.00 | 0.16 | 1,944.00 | 1.56 |
| United Kingdom | 5,198.00 | 252.00 | 7,216.00 | 7,000.00 | 12,414.00 | 7.35 | 7,252.00 | 5.81 |
| USA | 9,263.00 | 4,417.00 | 13,940.00 | 7,460.00 | 23,203.00 | 13.74 | 11,877.00 | 9.51 |
| **Subtotal** | 61,501.00 | 26,329.00 | 95,892.00 | 97,250.00 | 157,393.00 | 93.17 | 123,579.00 | 99.00 |
| **Non-Annex 1 party** | | | | | | | | |
| Argentina | 0.00 | 0.00 | 67.00 | 51.00 | 67.00 | 0.04 | 51.00 | 0.04 |
| Brazil | 426.00 | 49.00 | 317.00 | 359.00 | 743.00 | 0.44 | 408.00 | 0.33 |
| China | 317.00 | 0.00 | 230.00 | 88.00 | 547.00 | 0.32 | 88.00 | 0.07 |
| Costa Rica | 0.00 | 0.00 | 0.00 | 0.30 | 0.00 | 0.00 | 0.30 | 0.00 |
| El Savador | 0.00 | 0.00 | 0.00 | 140.00 | 0.00 | 0.00 | 140.00 | 0.11 |
| India | 33.00 | 96.00 | 195.00 | 132.00 | 228.00 | 0.13 | 228.00 | 0.18 |
| Malaysia | 163.00 | 0.00 | 141.00 | 114.00 | 304.00 | 0.18 | 114.00 | 0.09 |
| Mexico | 11.00 | 0.00 | 19.00 | 38.00 | 30.00 | 0.02 | 38.00 | 0.03 |
| Singapore | 0.00 | 0.00 | 22.00 | 22.00 | 22.00 | 0.01 | 22.00 | 0.02 |
| South Africa | 39.00 | 0.00 | 0.00 | 0.00 | 39.00 | 0.02 | 0.00 | 0.00 |
| South Korea | 4,248.00 | 0.00 | 1,221.00 | 163.00 | 5,469.00 | 3.24 | 163.00 | 0.13 |
| Taiwan | 4,033.00 | 0.00 | 0.00 | 0.30 | 4,033.00 | 2.39 | 0.30 | 0.00 |
| Thailand | 58.00 | 0.00 | 0.00 | 0.00 | 58.00 | 0.03 | 0.00 | 0.00 |
| **Subtotal** | 9,328.00 | 145.00 | 2,212.00 | 1,107.60 | 11,540.00 | 6.83 | 1,252.60 | 1.00 |
| **Total** | 70,829.00 | 26,474.00 | 98,104.00 | 98,357.60 | 168,933.00 | 100.00 | 124,831.60 | 100.00 |

All of this means that China's "strong technological capabilities," an expression used by Dechezleprête et al., does not imply that China has enough technologies for CDM projects and thus needs not rely on international technology transfer. The expression merely suggests that China has desirable technological skills to facilitate technology transfer. Thus, Dechezleprête et al.'s conclusion that China's "strong technological capabilities" are positively correlated with the country's relatively high level of technology transfers is logical.

### *2. Emphasis on Science and Technology*

China's relatively strong technological capabilities stem from the country's emphasis on science and technology. The *Scientific & Technological Actions on Climate Change* stipulates explicitly that "science & technology shall play a basic and leading role in response to climate change."[110] It further identifies some targets to be met by 2020. For example, it vows to "significantly improve the capability for making independent innovations in the research on climate change," to "make breakthroughs in and wider applications in social and economic sectors of key technologies related to GHG emission control and climate change mitigation," and to "notably enhance the adaptive capacity of key sectors and typical venerable areas in response to climate change."[111]

A set of recent data appears to show that China's pledges are supported by actions. From 2001 to 2006, China gradually increased its research and development (R&D) expenditure from approximately 1% of its GDP to almost 1.5%. The World Bank concludes that if this increasing trend continues, China's target of spending 2% of its GDP on R&D by 2010 can be achieved.[112] Specifically, in 2006/2007, China's gross domestic expenditure on R&D was reportedly $48.8 billion, putting the country behind the United States ($343.7 billion), Japan ($148.5 billion), and Germany ($73.8 billion), but far ahead of the other BRIC countries such as Brazil ($10.9 billion), India ($4.9 billion), and Russia ($10.6 billion).[113] In 2006, China granted 57,786 invention patents, behind only the United States (173,770), Japan (141,399), and Korea (120,790).[114] The number of R&D centers established in China by foreign companies has grown from 124 in 2001 to 1,160 in early 2008.[115]

110. China's Scientific & Technological Actions on Climate Change, *supra* note 48, Part III, at 4.
111. *Id.*
112. *See* Mid-term Evaluation, *supra* note 43, ¶ 3.29, at 27.
113. *See* MINISTRY OF SCIENCE & TECHNOLOGY OF P.R.C., CHINA SCIENCE & TECHNOLOGY STATISTICS DATA BOOK 10 (2008) (quoting sources from OCED and UNESCO), http://www.sts.org.cn/sjkl/kjtjdt/data2008/cstsm08.htm (follow "6 International comparison," Chart 6–1).
114. *See id.* at Chart 6–5.
115. *See China Industry: Wanted: Clean-Tech Firms*, ECONOMIST INTELLIGENCE UNIT, Sept. 5, 2008, http://www.newwavemarkets.com/country_markets/china/china_industry_wanted_cleantech_firms.

As for climate change related activities from 2001 to 2005, China invested more than RMB2.5 billion in scientific and technological research concerning climate change through national science and technology plans such as the National Hi-tech R&D Program and the National Basic Research Program. By 2007, these plans had obtained more than RMB7 billion to focus their research on energy conservation and emission reduction.[116] In addition, China has formed a team of over 1,000 specialists from different disciplines to focus on climate change research.[117]

China's commitment to science and technology does not seem to be affected by the global financial crisis. As stated in the *10 Point Stimulus Plan*, the government places emphasis on "infrastructure and other investment, although of a different nature than 10 years ago, with many projects geared to broad long term development needs."[118] The Chinese government plans to spend RMB370 billion on technological innovation from the fourth quarter of 2008 until 2010. As part of the *10 Point Stimulus Plan*, China has announced 10 sector-specific plans, many of which focus on environmental or energy efficiency. For example, the government plans to spend RMB500 billion in 2009/2010 in the petrochemical sector to upgrade refineries and improve the quality of fuel used.[119] Further, in May 2009 the Chinese government and the European Union signed the "China–EU Programme on Scientific and Technological Partnership" to deepen their scientific and technological collaboration in such fields as climate change, energy conservation and emission reduction, and the development of new energies.[120]

It should be noted that the driving force of China's science and technology has extended from the Chinese government to business enterprises. For example, from 2003 to 2006 the share of R&D funding contributed by business enterprises increased by nine percentage points, while that by the government decreased by slightly over five percentage points. The growing role of business enterprises in China's scientific and technological development is largely due to these enterprises' efforts in strengthening their innovative power to ensure their sustainable competitiveness in the global market.[121] In an attempt to further encourage enterprises to fund R&D activities, China's State Administration of

116. The Chinese government launched the National Hi-tech R&D Program and the National Basic Research Program in 1986 and 1997, respectively. *See* White Paper, *supra* note 11, pt. IV, at 27–28.

117. *See* China's Scientific & Technological Actions on Climate Change, *supra* note 48, at 3, pt. II.3.

118. The World Bank, *China Quarterly Update—March 2009*, *supra* note 74, at 17.

119. *See id.*

120. *See* Tian Fan, *Minister Praises China–EU Technology Partnership*, BBC MONITORING ASIA PACIFIC—POLITICAL, May 23, 2009.

121. *See* Mid-term Evaluation, *supra* note 43, ¶¶ 3.29–.30.

Taxation issued in December 2008 new rules to allow the pre-tax deduction of qualified enterprises' R&D expenses.[122]

### *C. PROJECT_SIZE*

#### *1. Findings Obscured by HFC-23 Projects*

Dechezleprête et al. find technology transfers in 43% of the 644 registered projects, which account for 84% of expected annual emissions reductions. The large difference between the two percentages indicates that projects with technology transfer are, on average, substantially larger than those without. This observation is partly due to the existence of 13 HFC-23 destruction projects, which involve technology transfer and represent more than 59 million tons of annual $CO_2$eq reductions. HFC-23 is produced during the manufacturing process of HCFC-22, an ozone-friendly refrigerant. Because the global warming potential of HFC-23 is 12,000 times higher than that of carbon dioxide, HFC-23 destruction projects generate enormous amounts of CERs.[123]

When this small number of mega-sized HFC-23 destruction projects is excluded from calculations, Dechezleprête et al. find that 42% of the 644 projects, which account for 71% of expected annual emissions reductions, involve technology transfer.[124] The large difference between 42 and 71, along with the econometric analysis of all 644 projects, shows that technology transfer does increase with the size of the project.[125]

For the case of China, Dechezleprête et al. find project size to have the third greatest positive impact on CDM-related technology transfer (see Figure 1). The average size of Chinese projects is much larger because China, a host country for most HFC-23 destruction projects, has had, by the time the authors conducted their analysis, seven huge projects of this type, which account for 80% of the country's annual reductions. Each of these seven projects uses technologies transferred from France or Japan.[126]

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122. Measures for the Administration of the Pre-tax Deduction of the Research and Development Expenses of Enterprises (Trial Implementation) (issued by the State Administration of Taxation, Dec. 10, 2008, effective Jan. 1, 2008), translated at CHINA L. & PRAC., Mar. 2009.

123. *See* Dechezleprête et al. 2008, *supra* note 6, at 1275–76.

124. *See id.* at 1275.

125. *See id.* at 1279–80.

126. *See* Dechezleprête et al. 2009, *supra* note 6, at 706.

Seres's econometric analysis of 3,296 registered or proposed CDM projects also shows that project size has a positive impact on international technology transfer. Seres finds technology transfers in 36% of these 3,296 projects, which account for 59% of the estimated annual emission reductions. Seres also analyzes separate groups of these 3,296 projects, including small-scale projects,[127] projects hosted by different countries, and projects of different sectors such as solar and hydro projects. He finds that within any group, technology transfer is still more common for larger projects.[128]

The above discussion shows the importance of excluding HFC-23 projects from the calculations because mega-sized HFC-23 projects could obscure the relationship between the project size and the rate of technology transfer. Another important reason for doing so is that although most HFC-23 projects involve international technology transfer, these projects have been criticized for undermining the value of the CDM, and grouping them with other CDM projects would boost the overall rate of technology transfer, making it difficult to see the transfer rate of more valued CDM projects.

There are four main criticisms directed against HFC-23 projects.[129] First, the technologies used in these projects are simple and end-of-pipe; the actual value of these projects in improving energy efficiency or in advancing sustainable development is thus limited. Second, these projects could provide perverse incentives for companies to produce more HFC-23 because the profits these companies could make through the enormous amount of CERs far exceeds the costs spent on destroying HFC-23. According to one study, HFC-23 destruction costs CDM

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127. Simplified modalities and procedures are provided for small-scale CDM projects. *See* United Nations Framework Convention on Climate Change [UNFCC], 1st Sess., Conference of the Parties Serving as the Meeting of the Parties to the Kyoto Protocol, decision 4/CMP.1, Annex II, FCC/KP/CMP/2005/8/Add.1 (Mar. 30, 2006), *available at* http://cdm.unfccc.int/Reference/COPMOP/08a01.pdf#page=43. The definitions for small-scale CDM project activities referred to in paragraph 6 (c) of decision 17/CP.7 was revised by "Further Guidance Relating to the Clean Development Mechanism" (decision 2/CMP.3), http://unfccc.int/files/meetings/cop_13/application/pdf/cmp_guid_cdm.pdf (advanced unedited version).

128. *See* Seres, *supra* note 6, §§ 4, 7.

129. *See, e.g.*, International Climate Change Programs: Lessons Learned from the European Union's Emissions Trading Scheme and the Kyoto Protocol's Clean Development Mechanism, GAO REPORTS, Nov. 18, 2008 (RPT-NUMBER: GAO-09-151), at 45–46 [hereinafter GAO REPORT]; Michael W. Wara and David G. Victor, *A Realistic Policy on International Carbon Offsets*, 11 (Stanford Univ. Program on Energy and Sustainable Development, Working Paper No. 75, 2008). *See generally* Michael Wara, *Measuring the Clean Development Mechanism's Performance and Potential*, 55 UCLA L. REV. 1759 (2008); Craig Hart et al., *East Asia Clean Development Mechanism: Engaging East Asian Countries in Sustainable Development and Climate Regulation Through the CDM*, 20 GEO. INT'L ENVTL L. REV. 645, 649–50 (2008); and Yang, *supra* note 78, at 690–91.

project developers less than $115 million, but payments to refrigerant manufacturers, investors, and China, the host country, will total approximately $5.3 billion.[130]

Third, HFC-23 projects should not be approved in the first place because they violate the CDM's principle of additionality. According to the Kyoto Protocol, emissions reductions from any CDM project must be "additional to any that would occur in the absence of the certified project activity."[131] Thus, project developers cannot obtain CERs for business-as-usual emissions reductions. They must show that the project would not be economically viable without funding through the CDM program. As discussed above, HFC-23 projects are inexpensive to implement and could be viable outside the CDM structure. Finally, the enormous amount of CERs issued by HFC-23 projects drive down the price of carbon credits, making other valued projects such as renewable energy projects that require more upfront investment less economically viable under the CDM. As a result, less investment can be made in these valued projects.

### *2. Challenging CDM Approval Process*

The positive correlation between project size and CDM-related technology transfer is, as explained by Dechezleprête et al., due to the ability of larger projects to exploit economies of scale in technology transfer.[132] The overly strict CDM approval process, as discussed below, has been criticized for causing large transaction costs and high financial risks in CDM projects. These are major impediments to potential developers of smaller projects, many of which are renewable energy projects and could promote the transfer of valued technologies.

The approval process of CDM projects takes place both at the international and national level and is regulated by the Kyoto Protocol, the Marrakech Accords,[133] the CDM Executive Board, and the host country's domestic regulations. In the case of China, the owner of a

130. *See* Wara & Victor, *supra* note 129.
131. Kyoto Protocol, *supra* note 1, art. 12(5)(c).
132. *See* Dechezleprête et al. 2008, *supra* note 6, at 1280; Dechezleprête et al. 2009, *supra* note 6, at 708.
133. The Marrakech Accords prescribe in detail rules of meeting the targets stipulated in United Nations Framework Convention on Climate Change [UNFCCC], 7th Sess., Conference of the Parties, FCCC/CP/2001/13/Add.2 (Jan. 21 2002), *available at* http://unfccc.int/resource/docs/cop7/13a02.pdf.

typical CDM project has to go through the following steps from application to receipt of CERs:

1. The project owner alone, or with its foreign partner, submits to the NDRC the project application and other documents including the PDD.[134]
2. An expert review of the project is conducted by relevant organizations appointed by the NDRC. This review shall be concluded within 30 days.[135]
3. After the expert review, the NDRC submits the project application to the National CDM Board.[136]
4. Based on the conclusion made by the Board, the NDRC, the Ministry of Science and Technology, and the Ministry of Foreign Affairs jointly approve or reject the project, and the NDRC issues an approval letter accordingly.[137] A decision on any project application must be made by the NDRC within twenty days (excluding the expert review period) as of the date of accepting the application, unless the Chair or the Vice-chair of the NDRC allows to extend the time limit to thirty days. If this happens, the NDRC must inform the project applicant of this decision and its reasons.[138]
5. After the project is approved by the Chinese authorities, a Designated Operational Entity (DOE), a private third party accredited by the CDM Executive Board, will validate the project for registration. The DOE validates the application of the relevant methodology and certifies the project's compliance with the applicable rules and modalities. Once these requirements are met, the project developer may submit a request for registration with the CDM Executive Board. In practice, the project is then reviewed by the CDM Registration and Issuance Team for compliance with the applicable methodology.[139]
6. The project owner must, within ten days from receiving notice from the CDM Executive Board, report to the NDRC the Executive Board's decision.[140]

134. Measures, *supra* note 49, art. 18, ¶ 1.
135. *Id.* art. 18, ¶ 2.
136. *Id.* art. 18, ¶ 3.
137. *Id.* art. 18, ¶ 4.
138. *Id.* art. 18, ¶ 5.
139. *Id.* art. 18, ¶ 6. I thank Michael Wara, Assistant Professor of Stanford Law School, for his detailed explanation of this step.
140. Measures, *supra* note 49, art. 18, ¶ 7.

7. Once the project is registered with the Executive Board, the project participants are allowed to implement it. A different DOE is responsible for auditing and certifying requests for issuance of reduction emissions. Within fifteen days upon the DOE's issuance of the certification report, the Executive Board will issue CERs accordingly. The NDRC in China will keep records of the issued CERs.[141]

The first CER issuance for China CDM projects usually takes place one to two years after the NDRC receives the project application.[142] Since it only takes fifty to sixty days to get an approval (or a rejection) from the Chinese authorities (see Steps (1) to (4)), the bottleneck apparently exists in the international leg of the entire process. The estimated time of one to two years is consistent with the findings reported in a recent study. The study points out that the first CER issuance for a CDM project typically takes place one year after it is registered with the Executive Board. Adding the time needed to go from submission of the application to registration (less than a year, as pointed out by the same study) means that the first CER issuance for a CDM project, regardless of the host countries, usually takes place one to two years after the project application is submitted.[143]

The process is not only long but also costly. It is estimated that $80,000 to $230,000 is needed to go through all the steps from project preparation to registration with the CDM Executive Board. Once the project is registered, an amount of $20,000 to $35,000 is needed to implement it during the first year and $15,000 to $25,000 per year for subsequent years.[144] Worst of all, going through such a lengthy and costly process does not guarantee that the project will be registered or issued with the expected CERs. The risks involved discourage investment

141. *Id*. art. 20. *See also* Olivier Dubuis, *Clean Development Mechanism Projects in China*, CHINA L. & PRAC., Nov. 2006.

142. *See* Dubuis, *supra* note 141. *See also* Chris Wright, *Green Finance: Cleaning Up in China*, EUROMONEY, Sept. 2007 (reporting from interviews with China CDM specialists that "getting from signing a contract to seeing a credit takes 18 months to two years").

143. *See* GAO REPORT, *supra* note 129, at Figure 8. I am grateful to Michael Wara, Assistant Professor of Stanford Law School, for sharing the following comment: "In practice, many projects that have received registration much longer than two years ago have yet to request CER issuance and may never do so because they are under water with respect to transaction costs or non-CDM related implementation barriers."

144. *See* GAO REPORT, *supra* note 129, at Figure 8.

in smaller projects, many of which are renewable energy projects, the types that would otherwise have benefited from the CDM most.

The CDM has taken some measures to remedy the situation. For example, they have adopted simplified procedures for small-scale projects,[145] increased the Executive Board's supporting staff, and allowed similar projects to be bundled in one application.[146] Yet the backlog problem remains. By April 2007, the Executive Board accepted 82% of proposals and ultimately approved over 96%. But in the following year, those figures fell to 57% and 87%.[147]

The real problem lies in the project-by-project approval process that involves strict review to ensure that the project meets the additionality requirement, a major reason for half of the rejected applications. Some CDM stakeholders suggest that the process be made less onerous by scrapping the additionality requirement. They argue that additionality is unworkable because it is based on projections of what would have occurred in the absence of the CDM, which no one can estimate with certainty. These CDM stakeholders prefer clear technical standards for qualification.[148] The dissatisfaction with the project-by-project application of the additionality rule has grown since it was revealed that these meticulous efforts fail to screen out such non-additional projects as the HFC-23 projects.[149]

### *D. CREDIT_BUYER*

Dechezleprête et al. find that the involvement of foreign credit buyers favors CDM-related transfer of clean technologies to China. This is consistent with the global trend. According to Dechezleprête et al.'s calculations, a project with a credit buyer has a 16% higher probability of involving technology transfer than one without. The authors attribute the credit buyers' positive impact on technology transfer to their ability to help CDM project developers overcome financial barriers. As discussed above, before project developers can sell their CERs, they

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145. *See* United Nations Framework Convention on Climate Change, *supra* note 127.

146. *See A Moment of Truth: Climate Change*, THE ECONOMIST, May 17, 2008. The number of staff members has reportedly increased from twelve in 2005 to eighty-two as of May 2008. *See* Terry Wang, *Programmatic CDM projects in China*, CHINA ENERGY WEEKLY, Aug. 6, 2008.

147. *See id*; *China's Carbon Market Hit by Regulatory Uncertainties*, XINHUA FINANCIAL NETWORK NEWS, July 29, 2008.

148. *See id*; GAO REPORT, *supra* note 129, at 39–42.

149. *See, e.g., id.* at 40–41; Tony Parkinson, *How the Smart Guys are Making a Killing Out of the Carbon Credits Trade*, THE AGE (Austl.), Aug. 5, 2008, http://www.theage.com.au/business/how-the-smart-guys-are-making-a-killing-out-of-the-carbon-credits-trade-20080804-3q05.html; Wara & Victor, *supra* note 129.

have to go through a lengthy and costly process. Selling credits through a forward contract helps reduce these developers' financial burdens.[150]

Although the involvement of foreign credit buyers favors technology transfer to China, the resulting impact of such involvement is less than that from *GDP_GROWTH*, *TECH_CAPABILITY*, and *PROJECT_SIZE* (see Figure 1). This is largely because China does not offer favorable terms to optimize involvement from credit buyers and the resulting impact is thus limited.

There are three major restrictions imposed on credit buyers. The first one concerns ownership of CERs and revenue sharing. Article 24 of the Measures states that "emission reduction resource" is owned by the Chinese government and the "emission reductions" generated by a CDM project belong to the project owner. It continues to provide that "revenue from the transfer of CERs shall be owned jointly by the Government of China and the project owner," with the government taking different percentage of CER transfer benefit from different types of projects. For example, the government takes 65 percent of CER transfer benefit from HFC projects, 30 percent from $N_2O$ projects, and 2 percent from CDM projects in priority areas such as energy efficiency improvement. This means that no one, including credit buyers, can enter into a contract with the owner of a China CDM project to "own" immediately a portion of CERs generated by a CDM project or share the proceeds from sales of those CERs. In practice, credit buyers obtain CERs through a transfer of ownership from the CDM project owners but such a transfer already invokes Article 24 and the government can take certain percentages of CER transfer benefit. All of this is in effect a tax on CDM projects that affects the viability, and thereby the attractiveness to credit buyers, of CDM projects.[151]

Second, China's review of CER price, which should depend on the risks assessed by individual credit buyers, creates uncertainty for these buyers.[152] Article 15(1) of the Measures requires China's national CDM board to review the CER price when it examines CDM project activities. The authorities have claimed that there is no fixed base price and that the price review aims only at ensuring that the CER price is fair to the

150. *See* Dechezleprête et al. 2009, *supra* note 6, at 708.
151. *See* Rebecca Zhang, *A Guide to Clean Development Mechanism (CDM) Projects in China*, CHINA L. & PRAC., Nov. 2007; DLA Piper, *China And The Clean Development Mechanism* (2007).
152. *See, e.g.*, Dubuis, *supra* note 141; DLA Piper, *supra* note 151.

project owners. But, in practice, the NDRC was found to be reluctant to accept projects with CER price under \$9-10/$tCO_2$eq, even at a time when \$7-8/$tCO_2$eq should be considered acceptable.[153] This kind of practice has caused widespread belief that China does have a base price, which, as of February 2009, is rumored to be EUR 8 (\$10.39).[154]

Third, the mechanism in place does not give credit buyers an incentive to be involved in a project prior to registering with the Executive Board. Each prospective project owner must provide the NDRC with either an emission reduction purchase agreement or a letter of intent from a credit buyer to prove the CER price agreed to be paid by the buyer. Based on such proof, the board reviews the CER price. In reality, credit buyers are reluctant to commit to a transaction price without knowing the exact volume of CERs the project can generate.[155] They are also reluctant to be bound to pay the full price because the mechanism in China does not allow discount for advanced payment.[156]

### *E. SUBSIDIARY*

According to Dechezleprête et al.'s analysis, the involvement of China-based subsidiaries of parent companies from Annex 1 countries has zero impact on China CDM projects (see Figure 1). This does not follow the global trend, which indicates that the likelihood of technology transfer is 50% higher if a CDM project is implemented by the subsidiary of a parent company from an Annex 1 nation. Dechezleprête et al. attribute the significant impact of the involvement of subsidiaries to assistance from their parent companies, ranging from helping manage the CDM registration to providing easier access to capital and technological expertise.[157] But the authors did not explain their finding about China.

China has shown such a different trend from the global pattern mainly because Chinese law prohibits foreign enterprises from having majority ownership of CDM projects. Article 11 of the Measures states that "Chinese funded or Chinese-held enterprises within the territory of China are eligible to conduct CDM projects with foreign partners." Arguably, this provision only affirms the eligibility of Chinese funded or

153. *See* Dubuis, *supra* note 141; Jing Yang, *China to Raise CER Floor Price This Year Due to Renminbi Appreciation*, CHINA ENERGY NEWSWIRE, Apr. 2, 2008.

154. *See* Terry Wang, *CORRECTION: Ecos Carbon Finds Niche As CDM Financing Trend Shifts*, CHINA ENERGY NEWSWIRE, Feb. 13, 2009.

155. *See* Dubuis, *supra* note 141.

156. *See* WILLIAM CHANDLER & HOLLY GWIN, FINANCING ENERGY EFFICIENCY IN CHINA 15 (Carnegie Energy and Climate Program Report Dec. 6, 2007).

157. *See* Dechezleprête et al. 2009, *supra* note 6, at 708–09; Dechezleprête et al. 2008, *supra* note 6, at 1282–83.

Chinese-held enterprises to conduct CDM projects with foreign partners, and it does not necessarily disqualify foreign enterprises from having majority ownership of CDM projects. But any remaining doubt is cleared by Article 17 of the Measures, which points out that "project owner" only refers to "Chinese funded or Chinese-held enterprises."[158] A "Chinese-held enterprise," as further clarified by China's Ministry of Science and Technology, is an enterprise with at least 51% of the shares held by Chinese parties.[159] This means that foreign investors cannot hold more than 49% of shares of the CDM project company in China. The ownership restriction strongly discourages China-based subsidiaries of companies located in Annex 1 countries from getting involved in CDM projects because foreign parties normally want, through their majority holding, to control technology transfer or other technical challenges involved in the projects.[160] As a result, the impact from these subsidiaries on international technology transfer to China, compared with other drivers of technology transfer, is negligible. Over the past years, investors have pushed for the elimination of this restriction.[161]

Other restrictions in China exacerbate the problem. These include the prohibition on foreign investors to collect an interest rate commensurate with risks involved on any shareholder loan made by the investors and the prohibition on foreign investors' preferred stock investment to stop them from getting a priority return on investment.[162] Although the latter prohibition could in theory be overcome by establishing a Cooperative Joint Venture (CJV) to explicitly specify in the agreement priority investment return to the foreign investor,[163] officials in charge of China's CDM have reportedly confirmed that such CJVs are not allowed to

158. Measures, *supra* note 49, arts. 11, 17.

159. Notice Concerning Recommending CDM Projects (issued by the Ministry of Science and Technology, effective Mar. 23, 2005).

160. *See* Dubuis, *supra* note 141; Zhang, *supra* note 151.

161. *See, e.g.*, *European Investors Pushing against Barriers in Chinese Energy Sector*, CHINA ENERGY NEWSWIRE, Sept. 10, 2008 (referring to a position paper prepared by the European Union Chamber of Commerce in China that specifically calls for the elimination of the 51% rule); *Too Many Restrictions in China's Carbon Market–Trader*, XINHUA FINANCIAL NETWORK NEWS, Dec. 4, 2007.

162. *See* CHANDLER & GWIN, *supra* note 156, at 12–13.

163. Measures for Examining and Approving the Advance Recovery of Investment by Foreign Partners of Chinese and Foreign Cooperative Joint Ventures (promulgated by the Ministry of Finance, June 9, 2005, effective Sept. 1, 2005), LAWINFOCHINA translated at http://www.lawinfochina.com/law/display.asp?db=1&id=4340&keyword=Measures%20for%20Examining%20and%20Approving%20the%20Advance%20Recovery.

develop CDM projects.[164] China's new Company Law has prompted discussions that a "preferred stock" structure may be possible under the new regime.[165] But the lack of explicit reference to the two-class stock structure in the new Company Law makes it unlikely that Chinese CDM authorities will change its stance to allow foreign investors' priority investment return.

Prior to the adoption of the new foreign exchange rule in 2008, the control over foreign investors' ability to repatriate foreign exchange was another restriction.[166] Given that China has changed from a country with scarce foreign currency to a nation with $1.95 trillion foreign exchange reserves,[167] China's 1996 *Regulations for the Control of Foreign Exchange* was revised in August 2008 to control the inflow, instead of the outflow, of foreign currency.[168]

These restrictions reflect China's protectionist tendencies by resisting foreign ownership in sectors perceived to have impact on national economic security, even though such ownership would help access to technologies.[169] In fact, according to the GCI Report, on the item "prevalence of foreign ownership," China is ranked 105th out of the 134 economies, demonstrating that foreign ownership of companies in China is not as encouraged as in other economies.[170] China's prohibition on foreign ownership of CDM projects stems particularly from its concern over foreign exploitation of rights to ownership of emission credits, which the Chinese government considers to be a "national resource."[171] This concern, together with the suspicion that developed countries would use the mechanism to avoid their own responsibilities to reduce greenhouse gas emissions, largely explains China's initial resistance to support the CDM.[172] This attitude has not changed even though China has benefited economically and politically from the CDM and has thus become a great supporter of the CDM.[173] Economically, the CDM has

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164. *See* CHANDLER & GWIN, *supra* note 156, at 13.

165. *See* Greg L. Pickrell & Judy J. Deng, *Preferred Stock Structure: Theoretical and Practical Issues of Implementation in Chinese Foreign-invested Enterprises*, CHINA L. & PRAC., Oct. 2008.

166. *See* CHANDLER & GWIN, *supra* note 156, at 11–12.

167. *See China's Foreign Reserves Hit $1.95 Trillion at End of March*, CHINA DAILY, Apr. 11, 2009, http://www.chinadaily.com.cn/china/2009-04/11/content_7668745.htm.

168. Regulations for the Control of Foreign Exchange (2nd Revision) (promulgated by the State Council, effective Aug. 5, 2008), *translated in* CHINA L. & PRAC., Oct. 2008, at 77.

169. *See* Lewis, *supra* note 78, at 164.

170. *See* GCR, *supra* note 32, at 432.

171. CHANDLER & GWIN, *supra* note 156, at 16. *See also* Lewis, *supra* note 78, at 164–65.

172. *See* Lewis, *supra* note 78, at 164.

173. *See id.* 164–65.

brought into China investment on emission reduction projects and clean technologies, whereas politically, the CDM allows China to be seen as proactive on the climate change issue.[174]

Added to all of the above restrictions imposed on foreign investors is a barrier created by local governments. Article 18(1) of the Measures specifies, without elaboration, that local governments may facilitate the CDM project application.[175] In practice, local governments play a decisive role in choosing partners for projects implemented in their localities. Foreign companies generally do not have as good relations with local governments as local companies do, and foreign companies' chances of being chosen to implement a CDM project could thus be lower. This barrier to foreign investors manifests the problem of local protectionism practiced by local governments, a problem that has been extensively discussed in literature on doing business in China.[176]

One would argue, however, that the favoritism for local companies should be outweighed by local officials' interest in gaining access to foreign advanced technologies to tackle environmental challenges, an achievement that will help their promotion.[177] Findings of a study of eighty-five power plants across fourteen different provinces in China suggest that the current demand for advanced equipment in some localities is actually not strong. The study shows that many of these plants have not fully utilized their advanced equipment because they have to cut costs to counter the pressure resulting from rising fuel prices and government-set feed-in pricing. These plants, therefore, have either not operated some advanced equipment or used a cheaper but substandard fuel that renders the equipment ineffective.[178] Amid the current financial crisis, local officials' favoritism for local companies is

174. *See id.*; Weijun Gao et al., *Possibility and Potential of Clean Development Mechanisms in China*, ENVTL. RES. LTR. 2, Oct.–Dec. 2007, at 2, *available at* http://www.iop.org/ EJ/journal/erl; Chris Wright, *Green Finance: Cleaning Up in China*, EUROMONEY, Sept. 24, 2007.

175. Measures, *supra* note 49, art. 18(1).

176. *See, e.g.*, ANDREW H. WEDEMAN, FROM MAO TO MARKET: RENT SEEKING, LOCAL PROTECTIONISM, AND MARKETIZATION IN CHINA (2009); Chong-En Bai et al., *Local Protectionism and Regional Specialization: Evidence from China's Industries*, 63 J. INT'L ECON. 397 (2004).

177. For a discussion of the linkage between China's achievement in tackling environmental challenges and the performance appraisal system for local governments, see Mid-term Evaluation, *supra* note 43, at ch. 7, ¶ 7.38.

178. *See* Edward S. Steinfeld et al., *Greener Plants, Grayer Skies?*, MIT INDUS. PERF. CTR., Aug. 2008, at 23–24, http://web.mit.edu/ipc/publications/pdf/08-003.pdf.

expected to increase because of these officials' overriding concern about keeping local companies afloat and lowering the unemployment rate.[179]

Even if foreign companies are chosen to develop CDM projects, the lack of strong relations with local governments may hinder the project implementation so much that some projects reportedly stop halfway, causing tremendous loss to foreign investors.[180] These negative experiences may have further discouraged cautious foreign investors from getting involved in CDM projects and, therefore, lowered their potentially positive impact on technology transfer.

### *F. CHINA*

Dechezleprête et al.'s econometric analysis shows that factors captured by the dummy variable *CHINA* have significant negative impact on technology transfer to China. This variable captures factors not taken into account by other country-level variables, namely: *GDP_GROWTH*, *TECH_CAPABILITY*, *TRADE*, and *FDI_INFLOWS*.[181] Findings about *GDP_GROWTH*, and *TECH_CAPABILITY* are discussed above.[182] This section, therefore, analyzes findings concerning *TRADE* and *FDI_INFLOWS* and then discusses what other factors may be captured by *CHINA*.

#### *1. TRADE and FDI_INFLOWS*

Dechezleprête et al. use *TRADE* to measure a host country's trade openness. The variable is defined to measure the sum of a host country's exports and imports of merchandise divided by the country's GDP in the same year. The authors use *FDI_INFLOWS* to measure the share of FDI inflows in a host country's GDP.[183]

Dechezleprête et al. expected both variables to have positive impact on CDM-related technology transfer to a host country because strong empirical evidence indicates that trade openness and FDI promote international technology transfer.[184] But the econometric analysis yields different results. While, as expected, a host country's trade openness

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179. *See, e.g.*, Jayshree Bajoria, *Financial Crisis May Worsen Poverty in China, India*, COUNCIL ON FOREIGN REL., Nov. 20, 2008, http://www.cfr.org/publication/17812/financial_crisis_may_worsen_poverty_in_china_india.html.

180. *See China's Carbon Trading Market Potential*, BUS. DAILY UPDATE, Sept. 16, 2008.

181. *See* Dechezleprête et al. 2009, *supra* note 6, at 710.

182. *See supra* Part II.A, B.

183. *See* Dechezleprête et al. 2009, *supra* note 6, at 708. Both variables use the average values of the corresponding calculations for years 2000 to 2004. *Id.*

184. *See id.*

(*TRADE*) has a positive impact on CDM-related technology transfer, the share of FDI inflows in the host country's GDP (*FDI_INFLOWS*) is found to have negative impact.[185] Similar impacts are found in the case of China (see Figure 1). Dechezleprête et al. provide no further discussion of *TRADE* and suggest, without elaboration, that their finding about *FDI_INFLOWS* "may be due to the fact that capital links are already captured by the variable *SUBSIDIARY*."[186] The following paragraphs attempt to add some insights.

### *a. TRADE*

*TRADE* is found to have positive impact on CDM-related technology transfer to China, but the impact is smaller than that generated by *GDP_GROWTH*, *TECH_CAPABILITY*, and *PROJECT_SIZE* and is very close to that generated by *CREDIT_BUYER*.

The positive impact of China's trade openness is limited because while China is quite open to exports, it is actually not that open to imports. In 2007, China's exports accounted for 41.4% of its GDP (ranked 69th out of the 134 economies studied in the GCI 2008–2009).[187] In the same year, China's imports accounted for 33.1% of its GDP (ranked 93rd out of the 134 economies).[188] The primary reason for China's relatively lower level of imports compared with other countries is that the country has significant trade barriers. Overall, the effective trade-weighted tariff rate on imports to China is over 14%, putting the country in the 122nd position on this indicator of the GCI Index.[189]

With respect to clean technologies, the World Bank studied in 2007 that China's tariff barriers and non-tariff barriers could be as high as 15% and 25% respectively.[190] Compared with some other top greenhouse gas emitting developing nations, China's barriers were not extremely high. For example, Brazil's tariff barriers and non-tariff barriers could be as high as 18% and 145% respectively, whereas the

185. *See id.* at 709.
186. *See id.*
187. *See* GCR, *supra* note 32, at 474.
188. *See id.* at 473.
189. *See id.* at 430–31.
190. *See* Tim Wilson, *Undermining Mitigation Technology: Compulsory Licensing, Patents and Tariffs*, INST. OF PUB. AFFAIRS, Aug. 2008, at 8 (referring to data included in *International Trade and Climate Change: Economic, Legal and Institutional Perspectives* (World Bank 2007)).

respective percentages in India were 15% and 102%.[191] However, compared with high income OECD countries that only imposed at most 4% tariffs and set up zero non-tariff barriers, China was doing poorly.[192] The World Bank concluded in the study that tariffs and non-tariff barriers had impeded the transfer of clean technologies and their elimination could result in as much as 14% increase in the diffusion of these technologies.[193]

Apparently the Chinese government is aware of the inconsistencies between the country's trade barriers and its policies of promoting more transfer of clean technologies. China's Ministry of Finance announced in December 2008 that tariffs on specific items would be adjusted to support, among other sectors, "technologies that will benefit industrial upgrading and equipment manufacturing," as well as "energy and environment conservation."[194]

#### *b. FDI_INFLOWS*

A possible explanation of the negative impact of *FDI_INFLOWS* is that the more FDI in clean technology a host country can attract, the more difficult it is for a developer of a CDM project to satisfy the "additionality" requirement in the approval process, and, as a result, the lower the CDM-related technology transfer rate is.[195] In the case of China, the country's favorable policies on FDI in clean technology are, as discussed above, reflected in the 2007 Catalogue.[196] In fact, FDI in China, which has ranged between 2 and 4% of the country's GDP since the early 1990s, has been important to China particularly because of its role as the country's vehicle to access technology and managerial skills.[197]

The negative correlation between FDI and CDM-related technology transfer merits further research by adding a new variable, *FDI_CLEANTECH*, to Dechezleprête et al.'s econometric model. Unlike *FDI_INFLOWS*, which measures the share of all FDI inflows, regardless of the investment sectors, in a host country's GDP, *FDI_CLEANTECH* focuses on the FDI inflows in the clean technology sector only.

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191. *See id.*
192. *See id.*
193. *See id*.
194. *China to Keep General Tariff Level at 9.8 Percent in 2009: Ministry*, XINHUA ECON. NEWS SERV., Dec. 18, 2008, *available at* http://www.chinadaily.com.cn/bizchina/2008-12/18/content_7317990.htm.
195. For discussion of the additionality requirement, see *supra* Part II.C.
196. *See supra* Part II.A.
197. *See* Mid-term Evaluation, *supra* note 43, at 1.

A more rigorous approach is to use different variables to measure FDI in different types of clean technology. In this case, the negative correlation between FDI in a certain type of clean technology and the number of CDM projects of the same type involving technology transfer is likely to be more apparent. Dechezleprête et al. find that *SECTOR*, a dummy variable which captures sector-specific characteristics that are not captured by other variables, has negative impact on CDM-related technology transfer.[198] They also find the same pattern in the case of China (see Figure 1), but offer no explanation.[199] In Seres's study, he shows that different sectors display different trends of technology transfer (increases, decreases, or irregular trends).[200] All of this means that little information is available now to draw any meaningful conclusion, and rigorous study, as proposed here, may be useful.

### 2. *Factors Captured by CHINA*

Dechezleprête et al. show that factors captured by *CHINA* have significant negative impact on China CDM projects. They conclude that these factors—not captured by *TRADE*, *FDI_INFLOWS*, *GDP_GROWTH*, and *TECH_CAPABILITY*—play a strong role in explaining country differences.[201] But apart from suggesting that these factors may reflect administrative peculiarities such as differences in the intellectual property protection mechanisms and in the national CDM policies, Dechezleprête et al. provide no further discussion.[202] This section fills this gap by highlighting a few major problems in China that contribute to the negative impact of *CHINA* on CDM-related technology transfer.

#### a. *Technology Transfer Not Mandatory*

Under the CDM, a host country can decide whether or not technology transfer is mandatory. In his study, Seres finds that if a host country adopts mandatory technology transfer as a criterion in its CDM approval process, the rate of technology transfer involved in its CDM projects increases.

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198. *See* Dechezleprête et al. 2009, *supra* note 6, at 708–09.
199. *See id.* at 709–10.
200. *See* Seres, *supra* note 6, § 13.
201. *See* Dechezleprête et al. 2009, *supra* note 6, at 710.
202. *See id.*

Seres focused on four countries: Brazil, China, India, and South Korea. These four countries' CDM projects account for 72% of all the 3,296 registered or proposed projects analyzed in Seres's study, and they represent almost 80% of the annual emission reductions.[203] Among these four countries, South Korea is the only country that adopts mandatory technology transfer requirement for the CDM approval process. The requirement prescribed by the South Korean authorities is that "environmentally sound technologies and know how shall be transferred."[204] Technology transfer for South Korean projects is found to be above the average measured in both the share of projects (49% vs. 36%) and the share of annual emission reductions (82% vs. 59%)(see Table C). Technology transfer for projects in Brazil, China, and India are all below average in these measures (Table C).[205]

TABLE C

| | TECHNOLOGY TRANSFER CLAIMS AS PERCENT OF | |
|---|---|---|
| | Number of Projects (%) | Annual Emission Reduction (%) |
| Brazil | 28 | 57 |
| China | 28 | 59 |
| India | 16 | 41 |
| South Korea | 49 | 82 |
| **Average** | **36** | **59** |

For the case of China, Article 10 of the Measures provides that "CDM project activities *should* (*ying*) promote the transfer of environmentally sound technology to China."[206] The word *should*, instead of *shall*, is used. This clearly shows that the provision does not impose any mandatory requirement for technology transfer to China.[207]

203. *See* Seres, *supra* note 6, § 6.

204. *See id.*, at 9, citing Yeon-Sang Lee, The DNA & Focal Point Workshop: Implementation in Korea (May 26–27, 2006). In Seres's report, the citation is: "Lee, Yeon-Sang. 2006. *CDM Implementation in Korea.* Presentation made at the DNA and Focal Point Workshop (Mar. 27–28). Vancouver, BC, Canada."

205. *See id.*§ 6, tbl. 4.

206. Measures, *supra* note 49, art. 10 (emphasis added).

207. *See also* Wang Rui, *Clean Development Mechanism: Untapped Potential*, China Law Insight (Nov. 10, 2008), http://www.chinalawinsight.com/2008/11/articles/corporate/foreign-investment/clean-development-mechanism-untapped-potential/ (for a similar comment on the lack of mandatory requirement for technology transfer to China).

### *b. Unclear Regulatory Framework*

Although CDM projects are regulated mostly by the Measures, these projects still need, as stipulated in Article 6 of the Measures, to be "consistent with China's laws and regulations, sustainable development strategies and policies, and the overall requirements for national economic and social development planning."[208] If a project, for instance, involves the establishment of a joint venture between a Chinese party and a foreign party, relevant foreign investment laws and regulations apply. If the project also involves a construction project, laws and regulations in this area must be followed. In fact, Article 19 of the Measures explicitly provides that "existing other relevant rules and procedures for the approval of construction projects shall apply to CDM projects."[209]

All of these requirements sound reasonable, but they could in practice discourage interested parties, including foreign technology companies, from getting involved in China's CDM projects. China's laws and regulations have often been criticized for their inadequate transparency and consistency.[210] Ensuring that CDM projects are consistent with China's laws and regulations could be challenging and sometimes frustrating.[211] Ensuring that CDM projects are in line with "sustainable development strategies and policies, and the overall requirements for national economic and social development planning" could be an extra burden because many of these strategies, policies, and requirements are vague and changed quite rapidly. Prospective project developers may find it necessary to consult different government agencies to ascertain the most up-to-date requirements. Currently, regarding "sustainable development strategies and policies," China's CDM Board considers favorably proposed projects that fall within any of the three priority areas: energy efficiency improvement, development and utilization of new and renewable energy, and methane recovery and utilization.[212]

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208. Measures, *supra* note 49, art. 6.

209. *Id.* art. 19.

210. *See, e.g.*, U.S. Dep't. of Commerce, *supra* note 40, at 39; DLA Piper, *supra* note 151; Dubuis, *supra* note 141. *See generally* CHINA'S LEGAL SYSTEM: NEW DEVELOPMENTS, NEW CHALLENGES (Donald C. Clarke ed. 2008); JANA KING ALLEN, PRACTICING TRANSPARENCY: FOREIGN LAWYERS IN CHINA'S TRANSITIONAL ECONOMY (VDM Verlag 2008).

211. For a detailed discussion of the "uncertain and nebulous" legal framework governing refuse-derived fuel projects, *see* Marco Carone & Edward Lehman, *Refuse-Derived Fuel Projects in China from a Legal Perspective*, CHINA L. & PRAC., July 2008.

212. Measures, *supra* note 49, art. 4; *See* DLA Piper, *supra* note 151, at 2.

Two examples illustrate how confusing the application of the Measures could be, let alone the application of other laws, regulations, and policies. These two examples concern the rule that restricts foreign investors to hold no more than 49% of shares of the CDM project company in China. First, although an equity joint venture in which the foreign partner can have more than a 49% equity share is clearly ineligible for owning a CDM project, would a CJV that formally meets the "Chinese-held" criterion but allows the foreign partner to control the decision-making process be disqualified? At issue is that according to Chinese law,[213] the decision process and the profit distribution of a CJV do not need to reflect the respective capital contributions made by the parties but can be subject to their negotiation. The NDRC, which is responsible for the interpretation of the Measures,[214] has not given a clear answer to this question.[215]

Second, are Hong Kong, Macau, and Taiwanese enterprises operating in mainland China considered foreign companies because they are so treated under China's foreign investment laws?[216] Chinese authorities have given mixed signals, leading to different advice rendered by experienced attorneys.[217] The situation seems to have been clarified in April 2009 when the Hong Kong government announced that the NDRC had "reinterpreted" the rules to allow Hong Kong companies to run China's CDM projects without restrictions on equity holding. To be eligible, the Hong Kong company (1) must be registered in Hong Kong and must have its main business location and headquarters in the city; (2) must be run by an executive director who is a Chinese national or Hong Kong permanent resident or must have a board of directors with at least half of the members who are Chinese nationals or Hong Kong permanent residents; and (3) must have at least 50% of its shares

213. Law on Chinese-Foreign Co-operative Joint Ventures (adopted Apr. 13, 1988, amended by the Standing Comm. Nat'l People's Cong., amended Oct. 31, 2000).

214. Measures, *supra* note 49, art. 25.

215. *See* Dubuis, *supra* note 141.

216. According to the Closer Economic Partnership Agreement and its supplements signed by China's Ministry of Commerce and the Hong Kong government, Hong Kong companies do enjoy preferential access to certain industries in mainland China. *See, e.g.*, Baker & McKenzie, *Status of Hong Kong Companies under China's Clean Development Mechanism (CDM) Rules: Close to a Breakthrough?*, Client Alert, Apr. 2009, http://www.bakernet.com/NR/rdonlyres/A9645974-EE51-46E0-BAA7-8BD1628E2D84/0/hk_statusofcompaniesunderCDMrules_ca_apr09.pdf.

217. Some attorneys advised that Chinese authorities had confirmed that Hong Kong, Macau and Taiwanese enterprises were considered domestic companies. *See* DLA Piper, *supra* note 151; Dubuis, *supra* note 141. Other attorneys advised the opposite. *See* Zhang, *supra* note 151; Melinda Xie & Monica Mo, *The Green Paper; Eversheds' China Renewable Energy Bulletin; Clean Development Mechanism*, Mondaq Business Briefing, Sept. 5, 2008.

classified as non-circular, if the company is a publicly tradable company.[218] Nevertheless, at the time of writing this article, the NDRC has not issued any formal document to confirm this "reinterpretation."

### *c. Ineffective Protection of Intellectual Property Rights*

Ineffective protection of intellectual property (IP) rights in developing countries is often cited as a barrier to the transfer of clean technologies.[219] Foreign investors and their governments have shared concern over China's weak IP protection mechanism. In a 2008 survey of 122 business executives in the United States, 53.8% saw little way to control IP theft in China.[220] Approximately 72% of these executives had operations in China and found the IP protection issue one of their top three concerns.[221]

The Commission of the European Communities has also warned European companies to guard against unwanted loss of technology and IP rights in China.[222] Similarly, while the U.S. Department of Commerce encourages U.S. businesses to tap into China's enormous clean technology market, it points out that "IP theft [in China] remains a major challenge to U.S. companies" and highlights the problem of "patent squatting."[223] The problem generally refers to the situation where many U.S. inventors fail to file for Chinese patents, allowing opportunists to review information disclosed in the U.S. patent filings and file for Chinese patents to claim rights against the inventors. From 1985 to 2008, parties from the United States obtained a total number of 71,848

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218. *See* Cheung Chi-fai, *Mainland Allows H.K. Firms to Run Green Projects; Relaxed Rules Give Conditional Access to Greenhouse Gas Market*, SOUTH CHINA MORNING POST, Apr. 8, 2009; Baker & McKenzie, *supra* note 216.

219. *See, e.g.,* Steven Knell, *Investor IP Concerns Hamper Climate Change Effort in China*, Global Insight, May 17, 2007. For a recent discussion of the topic, *see* John Barton, *Patenting and Access to Clean Energy Technologies in Developing Countries*, WIPO MAGAZINE, Apr. 2009, *available at* http://www.wipo.int/wipo_magazine/en/2009/02/article_0005.html.

220. *See* BTI Consulting, *2008 Annual Survey Results: Doing Business in China* (2008).

221. "Fraud and corruption" and "government stability and control" are the first two top concerns. *See id.*

222. *See* The Comm'n of the European Communities, *Technology Transfer To China: Guidance For Businesses, Technology Transfer To China —Why Worry?*, China IPR SME Help Desk, 2008, http://www.chinaiprhelpdesk.eu/media/docs/Tech_transfer_English.pdf.

223. U.S. Dep't of Commerce, *supra* note 40, at 39.

Chinese patents, lagging behind Japan (147,687). This is mainly because U.S. parties filed fewer Chinese patent applications (197,312) than their Japanese counterparts (300,141),[224] even though the former have consistently submitted the highest number of international patent applications under the Patent Cooperation Treaty.[225]

Patent squatting could occur because many U.S. parties did not know the differences between the patent protection system in China and that in the United States.[226] The United States follows the "first-to-invent" system to ensure that a patent be granted only to the inventor.[227] By contrast, China follows the "first-to-file" system, under which the first applicant to file for patent protection is usually awarded the patent.[228] Until recently, China adopted limited novelty requirements, under which patent protection could be barred if, prior to the filing date, a public use or knowledge of an invention had occurred *inside* China. In other words, such use or knowledge *outside* China did not bar patent protection.[229]

These concerns about China's poor IP protection record contribute to the low transfer rate of advanced technologies to the country. For example, the U.S. ethanol industry does not transfer its latest biological enzyme technology to China. But the industry transfers pre-treatment techniques for cellulosic ethanol because the technology is no longer advanced and the industry is, therefore, not concerned about competition from China.[230] However, if suppliers believe that they can retain control over their core technologies, these technologies may still be transferred to a country with poor IP record such as China.[231] For example, General

224. *See* State Intellectual Property Office, *2008 Annual Report*, http://www.sipo.gov.cn/sipo_English/laws/annualreports/AnnualReport2008/200906/P020090623340212540009.pdf.

225. *See Trends in PCT Filings: Leading Countries*, WIPO Statistics Database, Apr. 2009, http://www.wipo.int/export/sites/www/ipstats/en/statistics/pct/xls/qs_leadingcountries.xls.

226. *See, e.g.*, Kevin J. Zilka & Dominic M. Kotab, *Patent Novelty Requirements of the World and Strategic Foreign Patent Procurement Practices*, 2003, http://zilkakotab.com/PDFs/publication1.pdf.

227. *See, e.g.*, *id.* at 3.

228. *See, e.g.*, *id.* at 5.

229. Patent Law (promulgated by the Standing Comm. Nat'l People's Cong., Mar. 12, 1984, revised Sept. 4, 1992, Aug. 25, 2000, and Dec. 27, 2008, effective Oct. 1, 2009) LAWINFOCHINA, art. 22, http://www.lawinfochina.com/law/display.asp?db=1&id=7289&keyword=Patent%20Law [hereinafter Revised Patent Law. The most recent amendment to the Patent Law, which came into effect on October 1, 2009, adopts the absolute novelty standard. *See infra* text accompanying notes 236–37.

230. *See generally* M. Mani, *Warming up to Trade? Harnessing International Trade to Support Climate Change Objectives*, World Bank Group (2007).

231. *See* John H Barton, *Technology Transfer: Cooperation or Competition?*, CHINADIALOGUE.NET, Jan. 10, 2008, http://www.chinadialogue.net/article/show/single/en/1609.

Motors committed $250 million to an advanced research center in Shanghai to support the development of energy-efficient and environmentally friendly transportation alternatives. General Motors reportedly said that the company could "keep control of [its] intellectual property in China even while doing cutting-edge research."[232]

While more experienced corporations such as General Motors seem to have strategies to guard against IP theft, the same cannot be said about many venture-capital backed enterprises, a leading force of innovative clean technologies, because these start-ups do not have the experience, knowledge, or resources to adopt similar strategies.[233] Moreover, foreign investors often adopt an IP protection strategy by setting up wholly owned entities to run their operations in China.[234] The fact that China's Measures prohibit foreign investors from owning more than 49% of the CDM project company makes it impossible to use this strategy. All of these limitations in IP protection give support to a leading Chinese law firm's observation that even if technology transfer takes place, technologies imported to China under the CDM projects are often second or third class in exporting countries.[235]

China's recent amendment to the Patent Law ameliorates some concerns expressed by foreign investors.[236] For example, the amendment adopts the absolute novelty standard, under which a Chinese patent can only be given to an invention that is totally new worldwide.[237] It also increases the maximum amount for statutory compensation in China from RMB0.5 million to RMB1 million.[238]

The amendment to the Patent Law, however, also worsens foreign investors' concerns by providing a stronger statutory basis for "compulsory licensing."[239] For example, under the revised Patent Law,

232. *See* Kenneth Markowitz, *Technology Transfer: A Pillar of Climate Change Solutions*, Reuters Interactive Carbon Market Community, Nov. 5 2007, http://www.reutersinteractive.com/Carbon/80466.

233. *See China Industry: Wanted: Clean-Tech Firms*, *supra* note 115.

234. *See* Gordon Orr, *What Executives Are Asking about China*, McKinsey Q. Special Edition, 2004, at 16.

235. *See* Rui, *supra* note 207.

236. Revised Patent Law, *supra* note 229. *See* Weishi Li, *China Amends Patent Law*, Jan. 7, 2009, http://www.omm.com/china-amends-patent-law-01-07-2009/; Benjamin Bai et al., *What Does the Third Amendment to China's Patent Law Mean to You?*, Jones Day Commentaries, Jan. 2009, http://www.jonesday.com/pubs/pubs_detail.aspx?pubID=S5806.

237. Revised Patent Law, *supra* note 229, art. 22.

238. *Id.* art. 65.

239. *Id.* arts. 48–58.

the Chinese government may grant a compulsory license to a third party to use the patent if: (1) a patent holder has failed, without reasonable grounds, to exploit or sufficiently exploit the patent within three years after the issuance of the patent and four years after the filing of the patent application; or (2) the patent holder exploits the patent in a manner determined to be monopolistic behavior according to the law.[240] In addition, the new Patent Law goes beyond the standard—"for the treatment of contagious diseases"—prescribed in the *Measures to Implement Public Health-Related Compulsory Licensing* to allow compulsory licensing of pharmaceuticals for public health purposes.[241]

These new provisions enhance the Chinese government's ability to use compulsory licenses to produce patented products such as HIV/AIDS drugs and clean technologies without permission. Although the government has stated that it will be highly cautious in using the compulsory licensing clauses and will likely use them to merely negotiate with international pharmaceutical companies on their drug prices, companies with these technologies are unlikely to see these words as guarantees.[242]

China, like many other developing countries, justifies the need for using compulsory licensing to get access to clean technologies on the basis that the country cannot otherwise afford them.[243] Findings in Seres's study suggest that this justification is open to question. Seres finds that thirteen of the twenty-six project types have at least ten projects that involve technology transfer.[244] Agriculture, biogas, and biomass energy are three examples of these thirteen project types.[245] All of the thirteen types have their technologies supplied by companies from at least six countries.[246] Some of these types even have suppliers from more than twenty countries.[247] Among the project types that have a sufficient number of projects for analysis, Seres finds that project developers often have several prospective domestic or foreign suppliers

240. *Id.* art. 48.

241. *Id.* art. 50; Measures to Implement Public Health-Related Compulsory Licensing (promulgated by the State Intellectual Property Office, Nov. 29, 2005, effective Jan. 1, 2006), *available at* http://www.cecc.gov/pages/virtualAcad/index.phpd?showsingle=31889.

242. *See* Posting of Jia Hepeng to Intellectual Property Watch, and Yuan Yue, *Revised Chinese Patent Law Aims at Quality, Compulsory Licensing*, INTELLECTUAL PROPERTY WATCH (Jan. 15, 2009), http://www.ip-watch.org/weblog/index.php?p=1394&print=1; *Chamber Fears Climate Talks Could Set Stage for TRIPS Changes*, INSIDE U.S. TRADE, May 15, 2009, at 1, *available at* http://ourworldisnotforsale.org/en/article/chamber-fears-climate-talks-could-set-stage-trips-changes.

243. *See, e.g.*, Hong, *supra* note 11.

244. *See* Seres, *supra* note 6, § 12.

245. *See id.*

246. *See id.*

247. *See id.*

to choose from, and none of these suppliers dominates the market to restrict the distribution of the technology or keep the price high.[248]

These findings, along with the fact that compulsory licensing will likely prompt concerned investors and innovators to be more hesitant in making their technologies available in countries with such licensing, should alert developing countries, including China, to reconsider whether compulsory licensing is indeed warranted.[249]

### *d. Other Factors*

A few other factors in China also help explain the negative impact of *CHINA* on CDM-related technology transfer. First, China has policies that require CDM project developers to source a high percentage of their equipment from Chinese firms. For example, project developers of wind power projects must purchase at least 80% of their equipment from Chinese firms.[250] Foreign suppliers of more advanced wind turbines complain that this limits their opportunity to enter the Chinese market.[251] Chen Deming, Vice-Director of the NDRC, defended the policy: "If we want to reduce the cost of wind power, we need to use relatively advanced and relatively cheap equipment, and if we are using just

248. *See id. See also* John H. Barton, *Intellectual Property and Access to Clean Energy Technologies in Developing Countries: An Analysis of Solar Photovoltaic, Biofuel, and Wind Technologies* (International Centre for Trade and Sustainable Development, Issue Paper No. 2, 2007), *available at* http://www.iprsonline.org/New%202009/CC%20Barton.pdf. Barton finds that developing countries have access to solar photovoltaic and wind technologies at competitive prices. As observed by Seres, Barton's finding with respect to wind technologies is consistent with the data presented in Table 11 of Seres's study. As regards solar photovoltaic technologies, the number of solar projects analyzed in Seres's study is too small to support or reject Barton's conclusion.

249. For a recent discussion of whether compulsory licensing helps the transfer of clean technologies, *see* Nitya Nanda, *Diffusion of Climate Friendly Technologies: Can Compulsory Licensing Help?*, 14 J. INTELL. PROP. RTS. 241 (May 2009), *available at* http://nopr.niscair.res.in/bitstream/123456789/4193/1/JIPR%2014%283%29%20241-246.pdf.

250. *See* David Stanway, *Chinese Regulatory Hurdles Still Hinder Foreign Wind Power Firms*, XINHUA FINANCIAL NETWORK NEWS, Oct. 12, 2007.

251. *See id.* The complaints made by foreign suppliers of more advanced wind turbines are real concerns because almost all wind projects in China are CDM projects. *See* Wara and Victor, *supra* note 129, at 13.

expensive foreign equipment, that won't be possible."[252] Similar China-content policies are reportedly quite common in other sectors.[253]

Second, foreign companies with advanced clean technologies often see CDM projects as the first step to tap into China's bigger clean technology market. But the Ministry of Commerce's recent decision to prohibit the Coca-Cola Company from acquiring Huiyuan Juice Group, a well-known domestic brand, has heightened foreign investors' concern that China appears to have broadly interpreted its *Antimonopoly Law* to fend off foreign acquisitions of well-known local businesses.[254] This precedent does not help convince foreign companies of clean technologies that the long-term prospects of investing in China's clean technology market are promising.

Third, China's financing barriers make it difficult for foreign companies of clean technologies to expand their operations in China. Two commentators call China's financial system "inherently biased against clean energy investing" because of various barriers, including the country's "confiscatory tax policy."[255] In fact, China's weak financial market places the country in the 109th position (out of the 134 economies) on this indicator of GCI. This indicator covers the following items:

i. Financial market sophistication (83/134);[256]
ii. Financing through local equity market (80/134);[257]
iii. Ease of access to loans (99/134);[258]
iv. Venture capital availability (49/134);[259]
v. Restriction on capital flows (121/134);[260]
vi. Strength of investor protection (67/134);[261]
vii. Soundness of banks (108/134);[262]

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252. Stanway, *supra* note 250.

253. *See* Lewis, *supra* note 78, at 164; U.S.–China Business Council, *Foreign Investment in China*, Feb. 2007, http://www.uschina.org/info/forecast/2007/foreign-investment.html (last visited Nov. 4, 2009).

254. *See* Stephen Mulrenan, *Storm in a Juice Cup*, CHINA L. & PRAC., Apr. 2009, at 9; Zhan Hao, *Coca-Cola and Huiyuan: Explanation, Theory, An Attempt to Rationalise?*, CHINA L. & PRAC., May 2009, at 26.

255. CHANDLER & GWIN, *supra* note 156, at 8 (identifying four major barriers to clean energy finance in China: "restrictions on debt financing," "restrictions on foreign equity investments," "asymmetric policies at the central and local levels," and "confiscatory tax policy").

256. *See* GCR, *supra* note 32, at 450.

257. *See id.* at 451.

258. *See id.* at 452.

259. *See id.* at 453.

260. *See id.* at 454.

261. *See id.* at 455.

262. *See id.* at 456.

viii. Regulation of securities exchanges (109/134);[263]
ix. Legal rights index (93/134).[264]

Except for the availability of venture capital, China is ranked low on all items.

China has recently taken steps to remove some financing barriers. For example, the new *Implementing Regulations for PRC Enterprise Income Tax Law* came into effect in January 2008 to, among other things, grant qualified enterprises tax exemption for three years, followed by three-year taxation at 50% of the full tax rate.[265] Qualified enterprises include those engaging in projects involving power stations utilizing renewable energy or projects involving environmental protection and energy conservation.[266] These steps are welcome and will likely help the operations of foreign clean technology companies in China, and thereby, technology transfer. Research in this area is warranted when more data becomes available.

In sum, *GDP_GROWTH* is the biggest driver of CDM-related technology transfer to China because clean technologies companies from developed countries are willing to transfer some technologies to tap into China's enormous CDM and clean technology markets, which are the result of the country's strong policy and regulatory framework on energy efficiency and environmental protection. Such a strong policy and regulatory framework is, in turn, primarily due to the leaders' interest in promoting the country's economic development.

*TECH_CAPABILITY* is the second biggest driver because China's relatively good technological capabilities facilitate technology transfer by enabling the country to use transferred technologies relatively easily. China has strengthened its technological capabilities because of its emphasis on science and technology. These capabilities, together with increased diffusion of technologies transferred to China through earlier CDM projects or other investments, help China evolve to be a source of clean technologies. Despite these improvements, China still lacks the

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263. *See id.* at 457.
264. *See id.* at 458.
265. Implementing Regulations for PRC Enterprise Income Tax Law (promulgated by the State Council, Dec. 6, 2007, effective Jan. 1, 2008), art. 87, translated at CHINA L. & PRAC., Feb. 2008.
266. *See* Liu Yi & Wang Yaxun, *Policy Plans For Renewable Energy Project Financing*, CHINA L. & PRAC., Apr. 2009, at 25.

latest technologies, and the country can still benefit from international technology transfer.

*PROJECT_SIZE* has a positive impact on CDM-related technology transfer to China. This correlation is partly due to the presence of mega-sized HFC-23 projects that usually involve technology transfer, but is mainly due to the fact that larger projects can exploit economies of scale to stay viable throughout the costly and risky CDM approval process. In light of these costs and risks, the opportunities presented by the highly profitable and relatively less risky HFC-23 projects make smaller, but environmentally valuable, projects look even less attractive.

*CREDIT_BUYER* has a limited positive impact on technology transfer to China because China does not offer favorable terms to optimize credit buyers' involvement. These buyers cannot own CERs or share revenue generated from the sales of CERs. The CER price is subject to review by the Chinese authorities, whose suspected reliance on an informal base price renders the review process uncertain. In addition, the CDM in China does not provide credit buyers with incentives to commit to paying the full price prior to project registration.

Inconsistent with the global trend, *SUBSIDIARY* has no impact on CDM-related technology transfer to China because various protectionism-driven barriers discourage foreign investors from participating in China CDM projects. These barriers include those created by local governments, the ban on foreign enterprises' majority ownership of CDM projects, the prohibition on foreign investors' preferred stock investment, and the prohibition on foreign investors to collect an interest rate commensurate with risks involved on any shareholder loan made by the investors.

*TRADE* has a limited, though positive, impact on CDM-related technology transfer to China because while China is quite open to exports, it is actually not that open to imports, as reflected in the country's significant tariff and non-tariff barriers.

The unexpected negative impact of *FDI_INFLOWS* is possibly related to CDM's additionality requirement. The logic is that the more FDI in clean technology a host country can attract, the more difficult a developer of a CDM project can satisfy the "additionality" requirement in the approval process, and, as a result, the lower the CDM-related technology transfer rate is. Because of inadequate information, more research should be conducted to focus on trends displayed by different sectors. Additional research would also help explain the negative impact of *SECTOR* as found by Dechezleprête et al.

*CHINA* has a significant negative impact on CDM-related technology transfer. This is likely due to a few major problems in China, including the failure to use technology transfer as a mandatory requirement in the country's CDM approval process, an unclear CDM regulatory framework, the country's ineffective protection of IP rights, the requirement to use a high percentage of Chinese equipment to implement CDM projects, and the difficulty for foreign companies to expand their operations in China because of the Antimonopoly Law and financing barriers.

## III. CONCLUDING REMARKS

The future of the CDM remains unclear. Some experts and governments have called for its abolition.[267] Others have suggested that it be kept in the post-Kyoto framework but fundamental reforms must be implemented.[268] It is beyond the scope of this article to compare all the strengths of the CDM with its weaknesses. This article only examines the role of the CDM in the transfer of clean technologies to developing countries. In this context, Part II has shown major problems with the current CDM. If the UNFCCC decides to keep the CDM in the post-Kyoto framework, reforms must be undertaken to strengthen the role of the mechanism in technology transfer to developing countries. In addition, much can be done by developing countries, including China itself, to create domestic environments favorable to international technology transfer.

### *A. Lessons for Developing Countries*

Based on China's experience, developing countries should take at least the following steps to create a favorable environment for the transfer of clean technologies:

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267. *See, e.g.*, Padmaparna Ghosh & Jacob Koshy, *Europe Wants Emission Caps for India, China*, MINT, Feb. 9, 2009, http://www.livemint.com/2009/02/09001108/Europe-wants-emission-caps-for.html.

268. *See* White Paper, *supra* note 11, at 50; Li Jing, *China Issues Post-Kyoto Plans on Climate Change*, CHINA DAILY, Oct. 30, 2008, at 2, *available at* http://www. chinadaily. com.cn/china/2008-10/30/content_7156216.htm; Anne Eckstein, *Climate Change: EU Executive Puts Its Pawns in Place for International Talks*, EUROPOLITICS ENERGY, Feb. 11, 2009 (reporting that the European Commission has called for the reform of the CDM by using a sectoral crediting mechanism); Julio Godoy, *Climate Change: A Development Mechanism That Cleans Little*, INTER PRESS SERVICE, Mar. 18, 2009 (reporting that Lambert Schneider, a leading expert on CDM, opined that the mechanism should be radically reformed and eventually be eliminated).

1. Establish a strong policy and regulatory framework on energy efficiency and environmental protection to create investment opportunities to lure companies of clean technologies from developed countries.

Although China's shares of both the CDM and the clean technology markets are enormous, the pie is big enough for other developing countries to enjoy. Two studies have calculated that in order to save our planet from irreversible damage, approximately $500 billion needs to be invested in renewable energy and energy efficiency every year until 2030.[269] Over the past two years, the annual global investment in this area has been about $150 billion only.[270] Specifically, the International Energy Agency has found that $44 trillion should be invested in clean technologies from 2010 to 2050 to ensure a climate-safe future.[271]

Developing countries should have incentives to create these investment opportunities through the establishment of a strong policy and regulatory framework on energy efficiency and environmental protection. These opportunities would help invigorate their economies currently troubled by the global financial crisis. It is largely for this reason that a few countries have dedicated a large portion of their stimulus packages to green initiatives.[272] South Korea (81%) and the European Union (59%) are good examples.[273] China (38%) and the United States (12%), the two largest greenhouse gas emitting countries, dedicate smaller portions of their packages to green projects, but, in terms of volume, China outperforms all other countries by committing $221.3 billion, followed by the United States ($112.3 billion).[274]

2. Focus on science and technology to strengthen the country's technological capabilities to facilitate technology transfer.
3. Offer credit buyers favorable terms to optimize their involvement in CDM projects. In particular, unlike China, these countries should allow these buyers to own CERs or share revenue generated from the sales of CERs. To create less uncertainty to credit buyers, the CER price agreed upon by

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269. *See* Padmaparna Ghosh, *Downturn Takes a Heavy Toll on Investments in Clean Tech*, MINT, May 12, 2009, http://www.livemint.com/2009/05/11215744/Downturn-takes-a-heavy-toll-on.html (referring to the International Energy Agency's World Energy Outlook 2008 and a 2006 report written by economist Nicholas Stern).

270. *See id.* (referring to New Energy Finance data).

271. *See also* Michael Richardson, *Recession a Setback for Climate Change Talks*, THE STRAITS TIMES, Dec. 11, 2008, http://www.iseas.edu.sg/viewpoint/mr11dec08.pdf.

272. *See* Ghosh, *supra* note 269.

273. *See id.*

274. *See id.*

the parties to a CDM project should be based on the parties' assessment of project risks, instead of a base price set by the government.

4. Remove investment restrictions imposed on subsidiaries of companies from Annex 1 nations. For example, unlike China, developing countries should not prohibit these subsidiaries from owning more than 49% of the CDM project.
5. Enhance the country's trade openness to imports of clean technologies by lowering its tariff and non-tariff barriers
6. Strive to keep other country-specific problems to a minimum. In particular, adopt technology transfer as a mandatory requirement in the country's CDM approval process, establish a transparent and clearly defined CDM regulatory framework, improve the country's protection of IP rights, and reduce financing and anti-competition barriers to allow foreign companies to expand their operations in the country. In particular, developing countries should consider prudently whether compulsory licensing of clean technologies, an antithesis to protection of IP rights and, thereby, a barrier to technology development and transfer, is indeed necessary, and whether it might cause them more harm than benefit. Empirical evidence shows that in most CDM project types, none of the technology suppliers dominates the market to restrict the technology diffusion or to keep the price high.

### *B. Implications for the Post-Kyoto Framework*

The analysis in Part II also infers that the international community should take the following measures to facilitate the CDM-related technology transfer:

#### *1. Use Sectoral Approaches to Overcome Problems Arising from the Application of the Additionality Rule*

The positive impact of *PROJECT_SIZE* on CDM-related technology transfer to China stems mainly from the fact that larger projects can exploit economies of scale to stay viable during the costly and risky CDM approval process. Although the CDM has taken a few measures to speed up the process, such as adopting simplified procedures for small-scale projects and permitting similar projects to be bundled in one application, the backlog problem continues. The real cause of the problem is the strict review of each project against the additionality standard. However sensible the rationale behind this project-by-project application of the additionality rule is, the impediments such application has caused to potential developers of smaller but environmentally-sound projects and the unfortunate failure of these utmost efforts to screen out "nonadditional" HFC-23 projects have proven the impracticality of the rule and the need to modify it.

Sectoral approaches such as "sectoral CDM" and "sectoral no-lose targets" have been considered as possible solutions to problems arising from the application of the additionality rule.[275] Definitions of these terms have varied in the literature. But the "sectoral CDM" usually refers to a project-based mechanism that applies baselines set at the business-as-usual (BAU) emission levels for different sectors, whereas the "sectoral no-lose targets" usually refers to a mechanism that includes the entire sector in the boundary and overall emissions in the sector are credited against a baseline set below the BAU emission level.[276]

Among the supporters of the sectoral approaches is Lex de Jonge, Vice Chairman of the CDM Executive Board, who said,

> I see how we struggle with [the CDM] within the board. My feeling is that we manage to act on 400 to 500 projects on a yearly basis . . . But I don't think it's a sustainable process. I would very much welcome it if we could move towards a more sectoral approach . . . If we could say this is the baseline on a sectoral level, and you show your project is performing better than the baseline, and we declare additionality based on emissions compared to the baseline, then that would be much easier.[277]

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275. *See, e.g.,* Lambert Schneider and Martin Cames, *A Framework for a Sectoral Crediting Mechanism in a Post-2012 Climate Regime: Report for the Global Wind Energy Council*, May 28, 2009, *available at* http://www. oeko.de/oekodoc/904/2009-022-en.pdf; *Belgium: Post-Kyoto Climate Deal Takes Shape*, TENDERSINFO, May 23, 2009*;* China: U.N. CO2 Scheme Needs Energy Efficiency Focus – Developer, TENDERSINFO, May 9, 2009*;* Dario Montero, *Climate Change: Going Beyond the Carbon Market*, INTER PRESS SERVICE, Apr. 2, 2009 (reporting that John Nash, senior economist of the World Bank, said, "The Clean Development Mechanism must be expanded, including actions . . . to promote sector-based programs and policies that can achieve the scale of emissions reductions that we need").

276. For a good explanation of these terms, *see* Schneider and Cames, *supra* note 275, at 7–8.

277. Jing Yang, *CDM Scheme Successful in China—Vice Chairman of U.N. CDM*, CHINA ENERGY WEEKLY, Apr. 9, 2008.

Understandably, disagreements over where to draw the baseline for each sector are a major challenge.[278] Critics suggest that companies or their governments have incentives to exaggerate their current BAU emissions, making it easy for them to go below these baselines and be awarded CERs.[279] Independent experts have a lot to contribute to ensure that fair baselines are set. Hopefully, the potential benefits resulting from sectoral approaches would help interested parties put aside their differences to reach some agreements.

### *2. Prevent Mega-Sized but Low-Value Projects from Dominating the CDM Market*

The positive correlation between *PROJECT_SIZE* and CDM-related technology transfer to China is also partly due to the presence of mega-sized HFC-23 projects that usually involve transfer of simple technologies. These low-cost but extremely high return projects have naturally drawn investors from smaller, valuable projects. The UNFCCC needs to learn from these lessons to prevent similar mega-sized projects from coming into existence. To achieve this, CERs should be allocated to reflect not only the emission reduction value of a project but also its contribution to the transfer of clean technologies. For this reason, the technology-CDM proposed by some specialists is worth considering. This new mechanism requires, among other things, the technology transfer goal to be clearly identified in the CDM application and allows CERs to be shared by the technology provider and the host country's government if it offers support to facilitate the technology transfer.[280]

278. *See* Steven Gray, *Carbon Finance and the Low Carbon Economy*, CHINA DIALOGUE, Dec. 8, 2008, http://www.chinadialogue.net/article/show/single/en/2611-Carbon-finance-and-the-new-economy.

279. *See, e.g.*, Leigh Phillips, *Commission Warns Carbon Targets 'Risk Falling Short'* EUOBSERVER.COM, May 7, 2009, http://euobserver.com/885/28087.

280. *See* Fei Teng et al., *Possible Development of a Technology Clean Development Mechanism in the Post-2012 Regime*, Dec. 2008, http://belfercenter.ksg.harvard.edu/publication/18677/possible_development_of_a_technology_clean_development_mechanism_in_a_post2012_regime.html.

### *3. Help Strengthen Developing Countries' Technological Capabilities*

*TECH_CAPABILITY* is the second biggest driver of technology transfer to China because China's good technological capabilities enable the country to use transferred technologies relatively easily. China has made impressive investment in the development of science and technology, but many other developing countries may not have the means to have similar investment. According to the European Commission, there is a need to at least double the global energy-related research and development by 2012, and quadruple the current level by 2020, with emphasis on such clean technologies as renewable energy sources.[281]

At the Bali conference, China called for the establishment of an international fund to enhance mitigation, adaptation, research and development, and technology transfer in the developing world.[282] Later, China and G77 prepared a proposal on the same topic.[283] In May 2009, China reiterated its stance in a position paper titled *Implementation of the Bali Roadmap: China's Position on the Copenhagen Climate Change Conference*. In the position paper, the Chinese government, apart from requesting developed countries to reduce their greenhouse gas emissions to at least 40% below 1990 levels by 2020, asks these countries to donate at least 0.5 to 1% of their annual GDP to help developing countries upgrade technology, cut emissions, and adapt to the consequences of climate change.[284]

Understandably, the ongoing global financial crisis makes it harder for developed countries to accept this proposal. Yet, as discussed above, China's increased technological capabilities have also helped the country evolve to be an exporter of technologies to benefit less developed nations. In light of these long-term benefits of helping developing countries to strengthen their technological capabilities, a fund that supports this cause should be seriously considered.

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281. *See* Serge Abou, *Climate Change: EU, China Have Work to Do*, CHINA DAILY, Apr. 28, 2009, http://www.chinadaily.com.cn/bizchina/2009-04/28/content_7724203.htm.

282. *See China Proposes a Technology Transfer Fund at Bali Talks*, CHINA ECONOMIC REVIEW, Dec. 6, 2007, http://www.chinaeconomicreview.com/dailybriefing/2007_12_06/China_proposes_a_technology_transfer_fund_at_Bali_talks.html.

283. *See* U. N. Framework Convention on Climate Change, *Proposal by the G77 & China for a Technology Mechanism under the UNFCCC*, (Sept. 28, 2008), http://unfccc.int/files/meetings/ad_hoc_working_groups/lca/application/pdf/technology_proposal_g77_8.pdf.

284. *See* Press Release, P.R.C., Implementation of the Bali Roadmap: China's Position on the Copenhagen Climate Change Conference (May 20, 2009), http://en.ndrc.gov.cn/newsrelease/t20090521280382.htm.

Much of the success of the Copenhagen conference on climate change depends on whether parties to the UNFCCC can agree upon a post-Kyoto framework to facilitate the transfer of clean technologies from developed countries to the developing world. This study has shown that both the international community and developing countries themselves could contribute significantly to the development of an international framework and national environments that favor international transfer of clean technologies. Collaboration, not confrontation, is the key to tackling climate change.