A Sustainable Framework for International Green Technology Transfer

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"He who receives an idea from me, receives instruction himself without lessening mine; as he who lights his taper at mine, receives light without darkening me."[1] ~Thomas Jefferson

I. INTRODUCTION

The planet is almost certainly on a path towards devastating climate change driven by anthropogenic greenhouse gases ("GHGs").[2] From 1850–2000, the United States, the European Union ("EU"), Russia, and Japan created sixty-nine percent of all carbon dioxide ("CO_2") emissions.[3] Using cleaner technologies, many of those countries have begun slowing their growth rate of GHG emissions.[4] While the problem of GHGs from developed countries has in no way disappeared, another major problem is rapidly taking center stage: 5.7 billion of the world's 7 billion people live in "developing countries."[5] As those countries develop industrial economies, the potential for increased GHG production is devastating. It is estimated that developing countries will surpass the developed countries in GHG emissions in 2015.[6]

A key part of the effort to mitigate GHG emissions from developing countries is the transfer of low-carbon or "green" technology that can be used in place of the dirtier technologies that these countries already possess. Three significant challenges impede large-scale implementation of green technology transfer. First, concerns with recipient countries' intellectual property rights ("IPRs") systems can make companies or countries hesitant to transfer technologies. Second, there is no

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1. Letter from Thomas Jefferson to Isaac McPherson (Aug. 13, 1813), *available at* http://etext.virginia.edu/etcbin/toccernew2?id=JefLett.sgm&images=images/modeng&data=/texts/english/modeng/parsed&tag=public&part=218&division=div1.

2. HARRO VAN ASSELT ET AL., NATIONALLY APPROPRIATE MITIGATION ACTIONS (NAMAS) IN DEVELOPING COUNTRIES: CHALLENGES AND OPPORTUNITIES 21 (2010). ("In February 2007, the Intergovernmental Panel on Climate Change concluded with 90% certainty that human activities contribute to the increase in the global average temperature.").

3. Pew Center of Global Climate Change, *Cumulative CO_2 Emissions*, http://dev-pewclimateteam.p2technology.com/facts-and-figures/international/cumulative (last visited March 14, 2011).

4. *See An Atlas of Pollution: The World in Carbon Dioxide Emissions*, THE GUARDIAN, (Jan. 31, 2011), http://www.guardian.co.uk/environment/2011/jan/31/pollution-carbon-emissions (showing a visual representation of worldwide emissions and trends).

5. POPULATION REFERENCE BUREAU, 2011 WORLD POPULATION DATA SHEET 2, *available at* http://www.prb.org/pdf11/2011population-data-sheet_eng.pdf.

6. Environmental Protection Agency, *Global Greenhouse Gas Data*, http://www.epa.gov/climatechange/emissions/globalghg.html (last visited Feb. 27, 2012).

established system of accountability that takes the capacities and needs of each individual country into consideration. A system that categorizes each country as either developed or developing lacks the nuance to assess each country's technology transfer needs and obligations. Finally, a viable funding mechanism does not exist to address many of the costs inherent in creating and maintaining a system that addresses the challenges of green technology transfer.

With the above in mind, any system that transfers technology to developing countries must not create a disincentive for innovation, as continued innovation will be critical to solving the climate change problem.[7] If a company fears that the government of a country to which it is sending goods will allow the company's intellectual property ("IP") to be used (without appropriate compensation) to undercut the company's potential market—as is a fear in China[8] —it will be unlikely to transfer any of its best technologies to that country.[9] Conversely, if a country has a strong IPR system, it is more likely that there will be a flow of technology to that country.[10] While there are ways to paper over the cracks left by questionable IPRs in recipient countries through incentives or obligations, a lack of reliable IPRs will continue to hinder technology transfer.

The reasons why a two-category developed/developing country framework is problematic are most apparent when considering the situation in China. China is now the world's largest GHG emitter,[11] so transferring as much green technology as possible to China could have the greatest net result. While China is a "developing country" under the United Nations Framework Convention on Climate Change ("UNFCCC"),[12] it is far more advanced than many of the other developing countries, both in terms of economic and technological

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7. Keith E. Maskus & Ruth L. Okediji, *Intellectual Property Rights and International Technology Transfer to Address Climate Change: Risks, Opportunities, and Policy Options*, at 5 (Int'l Centre for Trade and Sustainable Dev. Intell. Prop. & Sustainable Dev. Series, Issue Paper No. 32, 2010).

8. *See* Norihiko Shirouzu, *Train Makers Rail Against China's High Speed Designs*, WALL ST. J. (Nov. 17, 2010), http://online.wsj.com/article/SB10001424052748704814204575507353221141616.html.

9. Maskus & Okediji, *supra* note 7.

10. *Id*. at 6–7.

11. *See* John Vidal & David Adam, *China overtakes US as world's biggest CO_2 emitter*, THE GUARDIAN (June 19, 2007), http://www.guardian.co.uk/environment/2007/jun/19/china.usnews (China has been the largest GHG emitter since 2007).

12. U.N. Framework Convention on Climate Change, Annex 1, May 9, 1992, 31 I.L.M.849 [hereinafter "UNFCCC"]. China is not part of the Annex I list of countries and for the purposes of the UNFCCC is considered to be a Developing Country Party.

capacity. China has the technological capacity to take IP developed and owned by a third party and use it to undercut the original IP owner by producing and selling (within China or in other countries) that same technology at a lower cost.[13] China is also a producer of new green IP.[14] Other developing countries lack the technological and industrial capacity to produce an end product after the transfer of green IP alone, instead requiring a transfer of an end product, and likely the personnel to install and operate the product until the proper knowledge can be transferred.[15] Because of this difference, treating China the same way as other developing countries in regards to green technology transfer policies is problematic because of China's capacity to use these transfers to produce products that compete with the original developers of the technologies. A potential model for the developed/developing framework is the structure created at the 7th Conference of the Parties ("COP-7") to the UNFCCC in Marrakesh in 2001. This structure has provided a solid framework for addressing particular countries' needs that has been refined in years since.

Any policy solution that addresses the above noted challenges, whether it develops from the UNFCCC or from another source, will have monetary costs. Finding this funding is a challenge in itself, one that I will touch on only briefly in this Note. A funding mechanism must be developed alongside the policy solution because without it, even the most brilliant system will fail.

This Note begins in Section II by discussing the development of international green technology transfer policies, touching on some economic, political, and environmental factors that have contributed to policy development over the last forty years. Section III addresses the current models of obligations and technology assessments that provide a potential foundation for a viable international technology transfer system. Recent changes to these models are also addressed. Section IV touches on one of the largest challenges to technology transfer, IPR, with a specific focus on the United States and China. Section V proposes steps for developing future technology transfer policy. Section VI concludes this Note by proposing future steps.

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13. *See* Shirouzu, *supra* note 8.

14. Maskus & Okediji, *supra* note 7, at 9.

15. UNFCCC, Enabling Environments for Technology Transfer, 16, U.N. Doc. FCCC/TP/2003/2 (June 4, 2003) [hereinafter "Enabling Environments"].

II. BACKGROUND: IMPORTANCE OF AND EFFORTS TOWARDS GREEN TECHNOLOGY TRANSFER

The environmental movement and the development of the science and computing power necessary to understand the potential impacts of GHG emissions[16] has spurred international environmental policy efforts to create an agreement to stabilize the climate system. Over the past forty years, our understanding of the impacts of anthropogenic GHG emissions has developed considerably, as has the international policy effort to control them. One facet of this policy effort is the transfer of environmentally-friendly or "green" technology to developing countries.

The bulk of GHG emissions have come in the last hundred years, mainly from sources in Europe, the former Soviet Union, and the United States.[17] Initially, concerns over emissions from "dirty energy" were focused on the immediate effects of soot and toxins.[18] Later, concerns over energy efficiency and eventually GHGs led to the production of more efficient industrial processes and energy production.[19] Developing countries cannot repeat this history. To minimize adverse impacts on the global climate system, developing countries need to implement industrial and energy production processes based on these cleaner technologies rather than follow the path taken by the United States and Europe. Because developing countries are focusing their efforts on developing

16. *See* PAUL N. EDWARDS, *Representing the Global Atmosphere: Computer Models, Data, and Knowledge About Climate Change*, *in* CHANGING THE ATMOSPHERE: EXPERT KNOWLEDGE AND ENVIRONMENTAL GOVERNANCE 31 (Miller & Edwards, eds. 2001).

17. *Global Greenhouse Gas Data*, *supra* note 6.

18. For a particularly devastating example, *see* Laura De Angelo, Encyclopedia of Earth, *The London smog disaster of 1952: London Smog Disaster, England*, http://www.eoearth.org/article/London_smog_disaster,_England (last visited Feb. 27, 2012). While it was not widely recognized for quite some time, the idea that anthropogenic GHGs can cause climate change has been around for over 100 years. *See* EDWARDS, *supra* note 16, at 41.

19. For example, average fuel economy for passenger cars in the United States rose from 13.5 miles per gallon ("MPG") in 1975 to 25.8 MPG in 2010. The bulk of that shift, however, came between 1975 and 1981, a response to the Arab oil embargos in the 1970s. Even the relatively modest rise in the late 2000s coincided with a spike in fuel prices. *See* UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, EPA-420-R-10-023, LIGHT-DUTY AUTOMOTIVE TECHNOLOGY, CARBON DIOXIDE EMISSIONS, AND FUEL ECONOMY TRENDS: 1975 THROUGH 2010 6 (2010), *available at* http://www.epa.gov/oms/cert/mpg/fetrends/420r10023.pdf.

their economies and not on developing clean technologies,[20] much of the clean technology will have to come from external sources.

A. What is Technology Transfer and Why is it Important?

Technology transfer is necessarily a broad term. Even with simple technologies, but especially with the often complex technologies involved in GHG reduction, a simple handoff of the technology will generally be ineffective at maximizing its implementation and effectiveness. For that reason, "[t]echnology transfer cannot be hardware transfer alone; it must necessarily involves [sic] building human and institutional capacity to handle the technology and the raising of awareness among users and other stakeholders, including civil society."[21] The United Nations Conference on Trade and Development ("UNCTAD") draft International Code on the Transfer of Technology, ("ICTT") supports this view by defining technology transfer holistically.[22] For these reasons, a view of technology transfer as only the transfer or licensing of specific IPRs is incomplete. Nevertheless, issues surrounding the transfer of specific IPR are critical and of major concern, especially for the most developed nations like the United States,[23] and will be the primary aspect of IPR addressed in this Note.

Two forces drive technology transfer. One pulls technology into markets, while the other pushes technology from them. Market-based forces tend to "pull" technology into markets where there is sufficient demand for the technology and sufficient economic means to entice technology owners to meet the demand.[24] This is the force that most developed countries rely on to transfer technology across borders.[25] The lack of resources to create sufficient financial incentive in developing countries impacts both their ability to purchase outside technologies and

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20. *See generally* Declaration on the Right to Development, G.A.UNGA Res. No. 41/128, Annex, U.N. Doc. A/RES/41/128 (Dec. 4, 1986), *available at* http://www.un.org/documents/ga/res/41/a41r128.htm.

21. MORGAN BAZILIAN ET AL., ENERGY RESEARCH CENTRE OF THE NETHERLANDS, CONSIDERING TECHNOLOGY WITHIN THE UN CLIMATE NEGOTIATIONS 24 (2008).

22. Gary Cox, *The Clean Development Mechanism as a Vehicle for Technology Transfer and Sustainable Development—Myth or Reality?*, 6/2 L. ENV'T. & Dev. J. 179, 182 (2010).

23. The U.S. House of Representatives voted 432-0 to oppose concessions at Copenhagen that would weaken American IP rights. CENTER FOR ENVIRONMENTAL PUBLIC POLICY, UNIVERSITY OF CALIFORNIA AT BERKELEY, WHO OWNS THE CLEAN TECH REVOLUTION? INTELLECTUAL PROPERTY RIGHTS AND INTERNATIONAL COOPERATION IN THE U.N. CLIMATE NEGOTIATIONS 11 (2009) [hereinafter "Berkeley"].

24. Enabling Environments, *supra* note 15, at 4.

25. *Id*.

the likelihood that technologies will be developed domestically to meet their specific needs.[26] Due to their lack of financial power, developing countries look to the developed countries to "push" the technology to them.[27]

Because most developed countries have free market rather than nationalized economies, they lack the ability or political will to apply sufficient leverage on private-sector technology owners to push their technologies to developing countries.[28] Developed country government actions that stimulate public and private sector transfers or enhance domestic capacity for technology development are commonly seen as creating a "push" force that many developing countries want to rely on.[29] In the end, a combination of both push and pull will likely be necessary for developing countries to receive significant green technology.

In addition, there are barriers to transfer. These include economic barriers, such as tariffs and other trade blocks, as well as social barriers to the uptake of technologies.[30] Economic barriers prevent the import of a superior technology while social barriers prevent technology from being widely adopted because it is foreign or against societal norms.[31] These barriers are beyond the scope of this paper, but are an important consideration in the design and execution of a functional technology transfer system.

Technology transfer is important because developing countries are rapidly growing and modernizing.[32] These shifts are driving up energy consumption and driving the staggering production of new power plants in China.[33] In the mid-2000s, China was bringing a new coal-fired power

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26. Maskus & Okediji, *supra* note 7, at 1.

27. Enabling Environments, *supra* note 15, at 4.

28. *Id*.

29. *Id*.

30. *Id.* at 4, 6–11; U. N. Dev. Programme, Handbook for Conducting Technology Needs Assessment for Climate Change, Advance Document, 6 (Sept. 2009) [hereinafter "TNA Handbook"].

31. *See* Enabling Environments, *supra* note 15, at 7–8; for an example of the social barriers to adoption of even simple technologies, *see* Karin Troncoso et al., *Social Perceptions about a Technological Innovation for Fuelwood Cooking: Case Study in Rural Mexico*, 35 Energy Policy 2799 (2007).

32. Projections of population growth in developing countries from 2008-50 are nearly ten times higher than in developed countries. *See* POPULATION REFERENCE BUREAU, *supra* note 5; China's Gross Domestic Product ("GDP") has grown at a rate between 9% and 10.3% over the past three years. *See* Cent. Intelligence Agency, *The World Factbook: China* https://www.cia.gov/library/publications/the-world-factbook/geos/ch.html.

33. Keith Bradsher, *China Outpaces U.S. in Cleaner Coal-Fired Plants*, N. Y. TIMES (May 10, 2009), http://www.nytimes.com/2009/05/11/world/asia/11coal.html.

plant, large enough to provide electricity to a major urban area, online every week to ten days on average.[34] Measured in terms of CO_2 per dollar of GDP, China is roughly five times dirtier than the United States.[35] Managing per-capita energy consumption in rapidly developing countries like China through the use of green technology instead of conventional technology will be essential for mitigating GHG emissions.

For a technology transfer regime to be viable, it must continually incentivize clean technology development. While a great deal of clean technology has been developed recently,[36] we are far from where we need to be. To meet global climate change goals,[37] we must innovate in the field of green technology at a rate two- to ten-times higher than current rates.[38] Any system that spreads green technology at the cost of reducing development of new green technologies may appear successful in the short term, but will fail to achieve necessary GHG mitigation in the long term.

B. Green Technology Transfer in International Climate Negotiations

The history of green technology transfer tells the story both of our growing understanding of climate change and international environmental policy. The story has its roots in the history of the environmental movement. Around 1970, the environmental movement in the United States scored a series of successes and was building steam on

34. Keith Bradsher and David Barboza, *Pollution From Chinese Coal Casts a Global Shadow*, N. Y. TIMES (June 11, 2006), http://www.nytimes.com/2006/06/11/business/worldbusiness/11chinacoal.html.

35. In 2005, the United States' GDP was roughly five times that of China's while emitting slightly less CO_2. Jane A. Legget et al., *China's Greenhouse Gas Emissions and Mitigation Policies*, CONG. RESEARCH SERV., (Sept. 10, 2008), http://www.fas.org/sgp/crs/row/RL34659.pdf.

36. *See generally* U.N. ENV. PROGRAMME ET. AL., PATENTS AND CLEAN ENERGY: BRIDGING THE GAP BETWEEN EVIDENCE AND POLICY, (Konstantinos Karachalios et al. eds., Sept. 30 2010), *available at* http://documents.epo.org/projects/babylon/eponet.nsf/0/cc5da4b168363477c12577ad00547289/$FILE/patents_clean_energy_study_en.pdf.

37. It is worth noting that the global climate change goals in terms of CO_2 concentrations in the atmosphere are continuing to develop. While the stated goal is limiting global temperature rise to 2°C, it is not clear what the cap on CO_2 concentrations must be to hit this mark. The original estimates appear to have been too high. *See* JAMES HANSEN ET AL., TARGET ATMOSPHERIC CO_2: WHERE SHOULD HUMANITY AIM?, *available at* http://arxiv.org/ftp/arxiv/papers/0804/0804.1126.pdf.

38. Maskus & Okediji, *supra* note 7, at 5.

an international level.[39] At the 1972 United Nations Conference on the Human Environment in Stockholm, Sweden, technology transfer for the benefit of the environment became a major issue for the first time.[40] Principle 9 of the resulting Stockholm Declaration stated that technology transfer was part of the environmental solution:

> Environmental deficiencies generated by the conditions of underdevelopment and natural disasters pose grave problems and can best be remedied by accelerated development through the transfer of substantial quantities of financial and technological assistance as a supplement to the domestic effort of the developing countries and such timely assistance as may be required.[41]

By the early 1990s, the international environmental movement had recognized climate change as a serious environmental threat, and in 1992, the United Nations produced the UNFCCC.[42] One of the major themes of the UNFCCC is "common but differentiated responsibilities."[43] This theme underlies the responsibility of developed countries to transfer green technology to developing countries. Article 4.1(c) addresses technology transfer specifically, calling on Annex I countries for the "transfer, of technologies, practices and processes that control, reduce or prevent anthropogenic emissions of greenhouse gases. . . ."[44] The UNFCCC also contains language in Article 4.3 on financial resources to encourage this: "[the developed country Parties] shall also provide such financial resources, including for the transfer of technology, needed by the developing country Parties to meet the . . . costs of implementing measures covered by [Article 4.1]."[45]

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39. Often seen as starting with Rachel Carson's Silent Spring, the environmental movement in the United States gained momentum throughout the 1960s, receiving significant recognition with the creation of the Environmental Protection Agency in 1970. *See generally* RACHEL CARSON, SILENT SPRING (1962); Natural Resources Defense Council, *The Story of Silent Spring*, , http://www.nrdc.org/health/pesticides/hcarson.asp; Jack Lewis, U.S. Env. Prot. Agency, *The Birth of the EPA*, http://www.epa.gov/history/topics/epa/15c.html.

40. Cox. *supra* note 22, at 182.

41. U. N. Conference on the Human Environment, Stockholm, Swed., June 5–16, 1972, *Declaration of the United Nations Conference on the Human Environment*, Principle 9, U.N. Doc. A/CONF.48/14 (1972).

42. UNFCCC, *supra* note 12.

43. *Id.* preamble, art. 3, art. 4.

44. *Id.* art. 4.1(c).

45. *Id.* art 4.3.

Technology transfer was also an element of the 1998 Kyoto Protocol,[46] which is perhaps the most well-known international environmental agreement. Article 10(c) of the Kyoto Protocol reiterates the commitment to the "development, application and diffusion . . . and … transfer of . . . environmentally sound technologies, know-how, practices and processes pertinent to climate change, in particular to developing countries."[47] It is worth noting that the language chosen is "in particular to developing countries," rather than a more direct statement with an exclusive focus on developing countries. This leaves open the idea that the developmental status of the receiving country is important, but not determinative, in the assessment of whether and what technologies should be transferred.

For the purposes of this Note, the most significant international agreement is the *Framework for meaningful and effective actions to enhance the implementation of Article 4.5 of the Convention* (hereafter "Marrakesh Agreement"), as laid out in Decision 4 produced at COP-7 in Marrakesh in 2001.[48] This agreement fully embraces the idea that the needs and strengths of each nation are different and thus the transfer of technologies requires an approach that recognizes these differences.[49] Decision 4, among other things, calls for supporting technology needs assessments and "enabling environments for technology transfer."[50] The Marrakesh Agreement also established the Expert Group on Technology Transfer[51] and charged it with monitoring the technology needs assessments.[52]

Later COP decisions, including the Bali Action Plan and Copenhagen Accord, expressed a deeper sense of urgency[53] and a stronger commitment, at least financially, to addressing climate change through technology transfer.[54] As the issue of technology transfer became more prominent, expectations of an international framework started to grow, and Copenhagen began to be the focal point for this

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46. Cox, *supra* note 22, at 185.

47. *Id*. at 186.

48. UNFCCC, Marrakesh, Morocco, Oct. 29–Nov. 1, 2001, *The Marrakesh Ministerial Declaration*, U.N. Doc. FCCC/CP/2001/13/Add.1, Decision 2/CP.7 (Jan. 21, 2002) [hereinafter *The Marrakesh Declaration*].

49. Cox, *supra* note 22, at 186.

50. *The Marrakesh Declaration*, *supra* note 48, at Dec. -/CP.7, ¶ 14.

51. Cox, *supra* note 22, at 186.

52. *The Marrakesh Declaration*, *supra* note 48, at Dec. -/CP.7, ¶ 2.

53. Cox, *supra* note 22, at 186 (The Bali Action Plan recognized the need for "deep cuts in global emissions.").

54. *Id*. (The Copenhagen Green Climate Fund was established with a commitment reaching $100 billion per year).

potential new framework. However, as the Copenhagen conference approached, expectations were lowered and in the end, the document produced was toothless.[55]

III. FOUNDATIONAL MODELS FOR A VIABLE GREEN TECHNOLOGY TRANSFER SYSTEM

The value of technology transfer to developing countries is clear; the challenge is maximizing the transfer of green technology through more effective international agreements. To make these agreements more effective, a set of tailored national obligations is critical. While there is no mechanism for creating a set of tailored obligations in the current technology transfer regime, such mechanisms exist in other areas of international climate change policy. Specifically, the Bali Action Plan's Nationally Appropriate Mitigation Actions ("NAMAs") provide a guide.[56] NAMAs provide a framework that moves beyond the too-simple developed/developing classification, which fails to address the broad spectrum of technology needs and capacities.[57] The Bali Action Plan's NAMA framework was further refined with some notable changes in the Cancun Agreements.[58] This section describes these foundational models to lay the groundwork for a proposed technology transfer system.

A. Assessment of Technological Capacities and Needs

Technology transfer is complex, requiring discrete considerations for each country, including the state of green technology development, industrial and production capacity, available natural resources, cultural considerations,[59] and the state of and respect for IP law.[60] Because of these individualized considerations, it is inappropriate to generalize

55. *See* Daniel Bodansky, *The Copenhagen Climate Conference: A Post-Mortem*, 104 Am. J. of Int'l L. 230 (2010).

56. *See* UNFCCC, Bali, Dec. 3–15, 2007, *Decisions adopted by the Conference of the Parties,* U.N. Doc. FCCC/CP/2007/6/Add.1, Decision 1/CP13, (March 14, 2008) [hereinafter *Bali Action Plan*].

57. *See The Marrakesh Declaration*, *supra* note 48 (using a developed/developing classification for technology transfers).

58. *See* UNFCCC, Cancun, Mex., Nov. 29–Dec. 10, 2010, *Decisions adopted by the Conference of the Parties*, Addendum, Part Two: Action taken by the Conference of the Parties at its sixteenth session, U.N. Doc. FCCC/CP/2010/7/Add.1 (Addendum 2), Decision 1/CP.16, (Mar. 15, 2011). [hereinafter *The Cancun Agreements*].

59. TNA Handbook, *supra* note 30, at 6.

60. Maskus & Okediji, *supra* note 7, at 6–7.

countries as either developed or developing with regard to technology transfer. Although initially complex, it is more effective to view the starting point for technology transfer as a large number of bilateral interactions between unique countries. An effective framework would be one where the unique qualities of each country and each interaction are accounted for rather than set aside in favor of existing labels. When the international community uses these individualized considerations as a starting point, it can build a more effective set of agreements for international technology transfer.

Fortunately, we do not have to start from scratch. There are already two complementary conceptual frameworks for this individualized approach in global climate change policy. The technology transfer plan in the Marrakesh Agreement provides a model for establishing the needs and capacities of individual countries in regards to green technology transfer[61] and the concept of NAMAs laid out in the Bali Action Plan provides an example for how to set mitigation obligations for each individual country.[62] We will first look at what exactly a NAMA is to better understand how it applies to this Note's proposed modifications to current technology transfer policy.

1. Establishing Obligations

While NAMAs seems like a concrete term, there is some disagreement over what it actually means.[63] Generally, it is useful to start with Article 3.1 of the UNFCCC, which states: "[t]he Parties should protect the climate system . . . on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Accordingly, the developed country Parties should take the lead in combating climate change and the adverse effects thereof."[64] This statement sets the stage for an individually tailored framework that assigns obligations to countries commensurate with their capacities to contribute. An individually tailored framework is key when the players span the spectrum from the least developed countries to the most. While NAMAs are not directed towards technology transfer, the tailoring of obligations for countries based on their capacities to meet the obligations can be applied to technology transfer.

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61. *See The Marrakesh Declaration*, *supra* note 48.

62. *See* Chia-Chin Cheng, *A new NAMA framework for dispersed energy end-use sectors*, 38 ENERGY POLICY 5614, 5620 (2010).

63. MARTINA JUNG ET AL., NATIONALLY APPROPRIATE MITIGATION ACTIONS, INSIGHTS FROM EXAMPLE DEVELOPMENT 1 (2010), *available at* http://www.ecofys.com/files/files/report_ecofys_nama_overview_eng_04_2010.pdf.

64. UNFCCC, *supra* note 12, art. 3.1.

The Bali Action Plan presents two types of NAMAs: NAMAs under 1(b)(i) ("1(b)(i) NAMAs"), which are intended for developed countries and are "[m]easurable, reportable, and verifiable nationally appropriate mitigation commitments or actions;"[65] and NAMAs under 1(b)(ii) ("1(b)(ii) NAMAs"), which are intended for developing countries.[66] The 1(b)(ii) NAMAs serve as a flexible way for developing countries to contribute to global reductions in GHG emissions.[67] These are generally not seen as legally binding instruments, while the 1(b)(i) NAMAs, on the other hand, are generally seen as legally binding.[68]

The difference in obligations between developed and developing countries is also reflected in UNFCCC Article 4.7, which recognizes that mitigation actions in developing countries depend on financial and technological support from Annex I countries.[69] Article 4.7 also recognizes that while climate change may be seen as a first-level crisis in developed countries, many developing countries have more immediate crises on their hands and are completely justified in focusing their energies there.[70] As Chinese Premier Wen Jiabao stated at Copenhagen, "action on climate change must be taken within the framework of sustainable development and should in no way compromise the efforts of developing countries to get rid of poverty."[71]

The Bali Action Plan and the UNFCCC provide a basis for creating binding obligations to mitigate climate change. The Marrakesh Agreement provides a system for establishing what those specific obligations should be and a plan that examines the technology capacity and needs of each country and encourages the adoption of new greener technologies.[72] The key part in a new technology transfer agreement needs to be a system for creating a country-specific plan for each country, an important departure from the simple developed/developing approach.

2. Establishing Needs

In addition to establishing obligations, there must be mechanisms at several levels to encourage the fulfillment of these obligations. First,

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65. *Bali Action Plan*, *supra* note 56, Decision 1/CP.13 art. 1(b)(i).

66. *Id*. art. 1(b)(ii).

67. VAN ASSELT, ET AL., *supra* note 2, at 26–27.

68. *Id*. at 28.

69. UNFCCC, *supra* note 12, art. 4.7.

70. *Id*. art. 4.7.

71. Peter Christoff, *Cold Climate in Copenhagen: China and the United States at COP15*, 19/4 ENV. POLITICS 637, 646 (2010).

72. *See The Marrakesh Declaration*, *supra* note 48.

there must be a way for stakeholders to coordinate and communicate to develop a robust market for low-carbon technologies.[73] Second, there must be mechanisms to develop partnerships between the various stakeholders in different countries and regions.[74] Third, there must be mechanisms to facilitate the development of projects involving the various stakeholders.[75] These mechanisms vary; some are financial tools, some are institutions, and others are methods of development.[76] The first step to selecting and creating the proper mechanism is establishing the needs and capacities of each country.

The United Nations Development Programme created the Technology Needs Assessment ("TNA") in order to establish individual country's needs.[77] TNAs are intended to "identify, evaluate, and prioritize technological means . . . to achieve sustainable development in developing countries"[78] and are executed by in-country, multi-disciplinary National TNA teams.[79] The process occurs in three main steps. First, each nation creates a National TNA team that identifies the stakeholders in the process.[80] Second, the TNA team and stakeholder groups identify a set of prioritized mitigation technologies and prioritized technologies for adaptation.[81] Third, the TNA team and stakeholder groups create a strategy for accelerating the adoption of the prioritized technologies.[82]

TNA teams are part of the assessed nation's government, not part of the United Nations or an outside group.[83] Each team is led by a project coordinator who is familiar with the way the TNA will tie back to the overall international plan, but each team focuses on its specific country.[84] The team must be broad enough to solicit input from a large number of stakeholders in the country, including the public and private sectors.[85]

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73. UNFCCC, *Mechanisms for Technology Transfer*, http://unfccc.int/ttclear/jsp/Mechanisms.jsp (last visited Fed. 25, 2012) [hereinafter *Mechanisms for TT*].

74. *Id*.

75. *Id*.

76. *Id*.

77. TNA Handbook, *supra* note 30, at 5.

78. *Id*.

79. *Id*. at 13.

80. *Id*. at 10.

81. *Id*.

82. *Id*. at 10, 68.

83. *Id*. at 13.

84. *Id*.

85. *Id*. at 8.

The team must also understand and coordinate with the finance sector.[86]

The team must be carefully chosen to "prevent . . . the prioritization of technologies [from being influenced] by stakeholders' views and perceptions on technology implementation."[87] That is to say, the group should be a low-carbon friendly group outside of the influence of the inertia of existing technologies (and perhaps "existing" political practices). In addition, the National TNA team personnel should be separate from the stakeholders in the process to avoid bias.[88]

To accurately evaluate its needs, the TNA team must work closely with the country's overall development plan.[89] Each nation has stakeholders that stand to benefit from (or be burdened by) the arrival of new low-carbon technologies. These range from the government, large industries, and utilities—all the way down to labor unions, farmers, and individual households.[90] It is important that the National TNA Team carefully identify relevant stakeholders to increase the likelihood of local acceptance of the resulting TNA.[91]

While the TNA teams look at individual countries, the Expert Group on Technology Transfer ("EGTT") was created to look at green technology transfer more broadly.[92] The EGTT was a nineteen-member panel of experts, representing both the most developed countries and less developed countries.[93] The EGTT was tasked with "enhancing the implementation of Article 4, paragraph 5, of the Convention and advancing the development and transfer of technology activities under the Convention," as well as "enhancing the implementation of the Convention provisions relevant to advancing the development, deployment, adoption, diffusion, and transfer of environmentally sound technologies to developing countries, taking into consideration differences in accessing and applying technologies for mitigation and

86. *Id*.

87. *Id*. at 9.

88. *Id*. at 13.

89. *Id*. at 8.

90. *Id*. at 15.

91. *Id*.

92. *See id*.; UNFCCC, EXPERT GROUP ON TECHNOLOGY TRANSFER: FIVE YEARS OF WORK (2007) [hereinafter EGTT FIVE YEARS]. At COP-16, the EGTT was terminated and the Technology Executive Committee was created, which has a very similar mandate. *The Cancun Agreements*, *supra* note 58, art. 121, 124.

93. The EGTT's membership consists of eight members from Annex I countries; three members each from Africa, Asia and the Pacific, and Latin America, and the Caribbean; one from the small island States; and one from "other non-Annex I Parties." UNFCCC, *Membership of the Expert Group on Technology Transfer*, http://unfccc.int/ttclear/jsp/EGTTMember.jsp (last visited March 17, 2011).

adaptation."[94] In essence, the EGTT was charged with developing the technology transfer system under the UNFCCC.[95]

The EGTT reported to the Subsidiary Bodies for Scientific and Technological Advice ("SBSTA"), which is the supervising body for the progress on development and transfer of technologies under the Bali Action Plan.[96] The SBSTA was created by Article 9 of the UNFCCC for the purpose of advising the Conference of the Parties on "scientific and technological matters relating to the Convention."[97] As the science and technology advising body for the Conference of the Parties, the SBSTA examines technology transfer mechanisms as well as the science, technologies, and methodologies surrounding climate change generally.[98]

B. Modifications Made at COP-16 in Cancun

In December 2010, the 16th Conference of the Parties ("COP-16") was held in Cancun, Mexico. The conference resulted in two important developments for green technology transfer.[99] Part IV of the COP-16 decision includes sections on "Technology development and transfer" (Section IV-B) and the Green Climate Fund (Section IV-A).[100] Section IV-B establishes a new Technology Mechanism aimed at improving the deployment and implementation of new clean technologies.[101] Section IV-A lays out the management of the Green Climate Fund, but leaves some substantive questions unanswered, namely the question of where the fund will be spent.[102]

Section IV-B begins by reaffirming the importance of nationally differentiated needs and obligations.[103] This section also lays out the Parties' priorities for technology development and transfer, which include (1) developing endogenous technologies in developing countries as well as transferring new technologies to them, (2) increasing investment in technology development, and (3) developing systems to monitor climate change and plans to mitigate it and adapt to it.[104] To

94. UNFCCC, *Expert Group on Technology Transfer*, http://unfccc.int/ttclear/jsp/EGTTTOR.jsp (last visited March 17, 2011).

95. EGTT FIVE YEARS, *supra* note 92, at 2.

96. TNA Handbook, *supra* note 30, at 4.

97. UNFCCC, *supra* note 12, art. 9, ¶ 1.

98. *Id*. art. 9.

99. *See The Cancun Agreements*, *supra* note 58.

100. *Id*.

101. *See id*. art. 117; Mechanisms for TT, *supra* note 73.

102. *See The Cancun Agreements*, *supra* note 58.

103. *Id*. art. 113–16.

104. *Id*. art. 120.

execute this mandate, Section IV-B establishes a two-part Technology Mechanism, consisting of a Technology Executive Committee ("TEC") and a Climate Technology Centre and Network ("CTC").[105]

The UNFCCC tasked the TEC with leading the technology transfer efforts and appears to be an updated version of the EGTT.[106] Despite the use of "Executive" in the title, the TEC is essentially a recommending body rather than an executive one, with directive language in its seven specified tasks consisting mostly of "[p]rovide an overview," "[c]onsider," "[r]ecommend," "facilitate," and "[s]eek cooperation."[107] The TEC's mandate is to gather information and provide recommendations to the Conference of the Parties, which retains executive power.

The CTC has a more concrete mandate.[108] The CTC has two main roles: to provide technology-related assistance to developing countries in the form of information and advice, and to provide a channel for communication and collaboration between "the private sector, public institutions, academia and research institutions" to facilitate the transfer of technology and know-how.[109] While the implementation of the CTC will require a great deal of effort from many qualified people, its output goals are clearly stated. The output goals of the Green Climate Fund ("Fund") are less well defined.

The language establishing the Green Climate Fund carefully lays out the governance of the Fund, the size of the board, who the trustee should be, and who should be involved in the further design of the Fund.[110] However, it leaves out two significant parts: where the money should come from and where it should go. Presumably, the forty parties of the Transitional Committee, tasked with designing the Fund, will provide this information, but it is a bit shocking that such critical elements were not incorporated in the original charter.[111] Article 102 provides the only direction for the Fund, stating that the Fund exists "to support projects, programmes, policies and other activities in developing country Parties using thematic funding windows."[112]

The Green Climate Fund presents an interesting opportunity from the standpoint of IPRs and clean technology. One way to use the Green

105. *Id*. art. 117–18.

106. *Id*. art. 121, 124; *see also The Marrakesh Declaration*, *supra* note 48, § C, art. 2.

107. *Id*. art. 121.

108. *See id*. art. 123.

109. *Id*.

110. *Id*. art. 102–11.

111. *Id*. art. 109.

112. *Id*. art. 102.

Climate Fund could be to provide royalty payments to the owner of IP that becomes subject to a compulsory license.[113] While it can potentially assist with legitimate compulsory licensing issues, the Green Climate Fund can do little to address the piracy problem with IPRs. IP owners have little recourse if their IP is simply stolen in a country with weak, or weakly enforced, IP laws. The black market does not give refunds and the Green Climate Fund does not have the capacity to be the financial backstop for international IPR enforcement failures.

IV. INTELLECTUAL PROPERTY RIGHTS

The creators of IP systems throughout history have understood an important truth about IP: the private market for IP will fail because, at its most basic level, it is non-rivalrous and non-excludable.[114] IPRs address this particular market failure by giving IP creators a government-backed right to exclude others from using their IP for a set period.[115] In exchange for this right, the IP creator must sufficiently and publicly disclose the details of their invention so that the public can learn from it and use it freely at the end of the period of exclusive right.[116] This exchange is intended to create the incentive to innovate and provide the tools for further innovation.[117]

One of the initial obstacles to the transfer of low-carbon technologies is the problem presented by IPR. On the one hand, many developing countries that need low-carbon technologies lack the strong IPR systems that would facilitate the transfer of low-carbon technologies.[118] On the other hand, many developed countries, like the United States, believe that strong IPRs equate to strong incentives to develop and transfer low-carbon technologies.[119] However, many

113. Compulsory licensing typically occurs when the proprietary technology meets a critical need but a license agreement cannot be reached, often for financial reasons. For more on compulsory licensing, *see* Section IV(c) *infra*.

114. Keith E. Maskus, *Encouraging International Technology Transfer*, at 5, (Int'l Centre for Trade and Sustainable Dev. Intell. Prop. & Sustainable Dev. Series, Issue Paper No. 7 2004).

115. Maskus & Okediji, *supra* note 7, at 12.

116. *Id*.

117. *Id*. This intention is explicit in the Constitutional language in which the United States patent system is rooted, calling for a system that "promote[s] the Progress of Science and useful Arts." U. S. CONST. art 1, § 8, cl. 8.

118. BAZILIAN, ET AL., *supra* note 21, at 27.

119. *Id*. It appears that in most cases, the developed country perspective is correct: "a comprehensive review of literature indicates that patent protection has a positive impact on technology transfer and rarely presents a barrier." CHARLES EBINGER & GOVINDA AVASARALA, THE BROOKINGS INSTITUTION, TRANSFERRING ENVIRONMENTALLY

developing and least developed nations argue the contrary, that strong IPRs are a barrier and promote "high costs and unjust protectionism."[120] As a general rule,

> individual countries prefer stronger patent protection when their capacity to innovate is greater, their domestic market is larger and the domestic demand for new goods is stronger. Poorer countries with weaker innovation capabilities rationally opt for weaker patent rights or other limitations on exclusive rights in order to gain cheaper access to new global goods and encourage reverse engineering and imitation by domestic firms.[121]

This situation is the root of the international IPR challenge and disincentivizes innovation.[122] Strong and predictable IPRs are therefore necessary to incentivize both the creation and the transfer of green technology internationally.

A. The United States

U.S. President Barack Obama has emphasized that the "transition to clean energy has the potential to grow our economy and create millions of jobs."[123] In his 2011 State of the Union Address, President Obama stated that the United States would "invest in biomedical research, information technology, and especially clean energy technology, an investment that will . . . create countless new jobs for our people."[124] Prior actions by the United States provide additional backup for President Obama's remarks.

The U.S. Chamber of Commerce lobbied hard against IPR concessions at the Copenhagen conference, leading the U.S. House of Representatives to vote 432-0 to oppose any such concessions.[125] In early December of 2009, immediately before the Copenhagen conference, the U.S. Patent and Trademark Office instituted an expedited review program for patent applications on environmentally friendly technologies.[126] While the program exists ostensibly to bring green

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SOUND TECHNOLOGIES IN AN INTELLECTUAL PROPERTY-FRIENDLY FRAMEWORK 9 (2009).

120. *Id*.

121. Maskus & Okediji, *supra* note 7, at 13.

122. *Id*.

123. The White House, *Energy & Environment*, http://www.whitehouse.gov/issues/energy-and-environment (last visited March 17, 2011).

124. President Barack Obama, State of the Union Address (Jan. 25, 2011).

125. Berkeley, *supra* note 23, at 11.

126. *The U.S. Commerce Department's Patent and Trademark Office (USPTO) will pilot a program to accelerate the examination of certain green technology patent*

technology to the market more quickly, the announcement's timing, immediately before Copenhagen, seemed to make a statement that the United States intended to retain strong IP rights with regard to green IP.[127]

B. China

China in some senses is playing an ecological game of chicken with the developed countries and China is driving a very big truck. China is barreling forward with development at a rate and scale that has led it to increase its GHG emissions eighty percent in the past twenty years.[128] This rapid expansion has China

> [c]aught in a Faustian policy trap. It needs ongoing domestic economic growth of around 8 per cent per annum to sustain social and political stability. Yet such growth will deliver massive ecological and associated social crises and undermine the prosperity growth is intended to provide, especially if based on fossil fuels including China's bountiful and cheap coal. Although China's trade revenue and national reserves are perhaps sufficient for it to ecomodernize rapidly, they are insufficient to manage the impacts of growth pursued by conventional means.[129]

Chinese President Hu Jintao has stated that China intends to continue on its course of rapid economic and social development, while "integrat[ing its] actions [to address] climate change . . . ."[130] At Copenhagen, Chinese President Hu Jintao stated that, "[d]eveloped countries should support developing countries in tackling climate change. This is not only their responsibility, but also serves their long-term interests."[131] China is essentially saying: "we are not going to slow down, so either help us reduce GHG emissions or don't complain when it gets hot in here."

The problem of transferring technology to China is China's bad reputation regarding IPRs. China has the capacity to reverse engineer technologies and produce a competing product quickly and cheaply.[132]

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applications, U.S. PATENT & TRADEMARK OFFICE, (Dec. 7, 2009), http://www.uspto.gov/news/pr/2009/09_33.jsp.

127. *Id*.

128. Christoff, *supra* note 71, at 645.

129. *Id*.

130. *Hu Jintao's speech on climate change*, N. Y. TIMES (Sept. 23, 2009), http://www.nytimes.com/2009/09/23/world/asia/23hu.text.html.

131. *Id*.

132. *See* Stephen Evans, *German firms fear China technology theft*, BBC.COM (Feb. 7 2011), http://www.bbc.co.uk/news/12382747.

Companies are concerned about sending products containing protected IP to China because they are afraid of being undercut by Chinese versions of their own products.[133] A recent example of this is new high-speed railways. Foreign companies, including Siemens and Kawasaki Heavy Industries, started building high-speed rail systems in China only to find that Chinese companies rapidly developed their own high-speed rail technologies by "learning and systematically compiling and re-innovating foreign high-speed train technology."[134] China is not the first country to accelerate technological development through loose protection of IPRs,[135] but its current approach has left some companies unwilling to transfer *products*, not just IPRs, to China.[136] Companies are left a Hobson's choice: they can enter the vast Chinese market and risk the theft of their IP or stay on the sidelines, foregoing potential profits.[137]

China is by no means wholly dependent on infusions of outside technology; it is developing some of its own low-carbon technologies.[138] The United States recognized this situation, although not directly naming China, when it suggested an "implementing agreement . . . [for] developing country Parties whose national circumstances reflect greater responsibility or capability."[139] This statement, contrasted with China's statements regarding responsibilities, reflects the serious divide between the viewpoints of the two countries. The United States would give much stronger support to a system based on the Marrakesh Agreement that treated each country differently, where China would prefer to see a simpler system that placed more responsibility on the developed countries and transferred more benefits to the developing country parties.[140] Ultimately, both countries are looking to act in their own economic self-interests.

C. Proposed IPR Policy Mechanisms

One technology transfer policy mechanism that has been proposed to sidestep the IPR problem is to treat green IP like pharmaceuticals, analogizing climate change to a health emergency.[141] Article 31 of the

133. *Id*.

134. Shirouzu, *supra* note 8.

135. Maskus & Okediji, *supra* note 7, at 7.

136. Shirouzu, *supra* note 8.

137. *Id*.

138. *See* Maskus, *supra* note 114.

139. VAN ASSELT, ET AL., *supra* note 2, at 28.

140. *See* Maskus & Okediji, *supra* note 7, at 5–6; *see* VAN ASSELT, ET AL., *supra* note 2, at 41.

141. EBINGER & AVASARALA, *supra* note 119, at 7.

Agreement on Trade-Related Aspects of Intellectual Property Rights ("TRIPS Agreement") provides for the use of patented technologies without the permission of the patent holder in cases of national emergency.[142] The pharmaceuticals approach, however, is a poor fit for green technology, both because of the traits of the technologies themselves and the problems they are designed to solve. Economically speaking, the nature of pharmaceuticals, with only one or a few patents on a particular drug and often a lack of market substitutes, allows the monopoly power granted by the patents to command a higher price.[143] One complete green technology, by contrast, involves a much larger number of separate patents, potentially owned by different companies, many of which may have already expired.[144] Further, there are several technology options to mitigate climate change, where there may be only one drug that is effective in treating a particular disease.[145] Finally, it is hard to deny that the emotional impact of a national health crisis is much greater than the creeping, barely perceptible, impacts of climate change, especially in developing nations.

Pharmaceuticals are not the only technologies subject to compulsory licensing. Certain agricultural technologies are sometimes transferred without licensing fees. "[T]here are examples of humanitarian-use licensing contracts . . . [that] transfer [their] proprietary technology to poor farmers without requesting royalty payments."[146] Like the pharmaceutical issue, these tend to focus on short-term humanitarian crises rather than long-term climate change goals.

One of the problems with compulsory licensing approaches is that there is far more to the successful adoption of low-carbon technologies than simply possessing a license to the patent; the associated skills and know-how do not come pre-packed with IPRs.[147] Granting a compulsory license alone would be like giving someone the design for a fishing rod, but teaching them neither how to build it nor how to fish. With this in mind, it is clear that compulsory transfers, accomplished without the cooperation of the IP provider, will likely be minimally effective.[148] Rather, a cooperative framework is required.

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142. Agreement on Trade Related Aspects of Intellectual Property Rights, art. 31, Apr. 14, 1994, 1869 U.N.T.S 299.

143. Berkeley, *supra* note 23, at 10–11; Maskus & Okediji, *supra* note 7, at 10.

144. Berkeley, *supra* note 23, at 10–11; EBINGER & AVASARALA, *supra* note 119, at 7.

145. EBINGER & AVASARALA, *supra* note 119, at 7.

146. Enabling Environments, *supra* note 15, at 5.

147. Maskus, *supra* note 114, at 10.

148. *Id*.

V. PROPOSED MODIFICATIONS TO CURRENT TECHNOLOGY TRANSFER POLICY

A robust cooperative framework will require three things. First, participant countries must ensure that they have sufficient IP laws and that they are enforced. Second, there must be an adequate funding mechanism for the transfer of IPRs. Third, there must be a system of accountability to push developed countries to encourage the transfer of domestic IPRs. Absent any one of these parts, an international framework is destined to fail.

The problem of weakly enforced IPRs in many countries is certainly not a simple one, but a system could be structured to create a "carrot" to encourage countries to strengthen their IPR systems. Participation in the technology transfer program and access to funding should be conditioned on the satisfactory enforcement of acceptably stringent IP laws. In some cases, of course, the concern over a weak IPR system is small. Countries that lack the capacity to undercut the market for a transferred technology in any meaningful way are of less concern than more advanced developing countries, like China. Because of this, specific tailoring of each country's obligations will be necessary, as facilitated by the TNA system discussed above.

This specific tailoring will help establish what are called "Enabling Environments" in all countries to maximize the opportunity and capacity for green technology transfer.[149] In technology-creating countries, the Enabling Environments must be ones that contribute to pushing the technologies outward to the countries that need them.[150] In less developed countries, an Enabling Environment is one that, among other things, creates at least some market pull that draws the technology in.[151] This means, "transparent and consistently applied administrative procedures, investment liberalization, competitive markets for cleaner technologies, adequate intellectual property protection, and sound environmental regulations."[152]

Enabling Environments are the result of "governmental actions, such as fair trade policies, removal of technical, legal, and administrative barriers to technology transfer, sound economic policy, regulatory frameworks and transparency, all of which create an environment conducive to private sector and public sector technology transfer."[153] The

149. Enabling Environments, *supra* note 15, at 3–4.

150. *Id*. at 4.

151. *Id*.

152. *Id*.

153. EGTT FIVE YEARS, *supra* note 92, at 7.

term Enabling Environments, rather than Enabling Policies or Enabling Agreements, is apt because "[n]o single instrument can overcome the barriers prevalent in both developing and develop[ed] countries for [Environmentally Sound Technology] diffusion."[154]

In the UNFCCC, the Annex II parties agreed to provide funding for the transfer of technology and other projects meant to mitigate climate change in developing countries.[155] There is potential for the funding mechanism to be the Green Climate Fund. Provided that there is little risk of IP theft, the transfer or licensing of technologies to developing countries could be facilitated by paying for the licenses as normal with the Green Climate Fund. Today, however, nearly twenty years after the creation of the UNFCCC, the global landscape has changed. The gap between the developed countries and the most advanced developing countries is much smaller.[156] A successful system will require some ownership on the part of the developing countries, or the developed countries will simply be subsidizing the demise of the green sector of their economies. For some countries, it may be more appropriate for the Green Climate Fund to contribute a portion of the licensing fees for a technology, rather than covering the fee in its entirety. For other countries, the funding could be covered partly through the sales of emissions offsets.[157] In the end, some level of *quid pro quo* seems appropriate.

The third concern is a lack of accountability. Even with a carbon tax or cap among developed countries that would incent innovation in low carbon technologies, the market would not lead to the transfer of green technologies to developing countries without an obligation or additional incentive.[158] Both the push of government pressure and the pull forces of the market remain weak.

This market failure can be remedied by overlaying a regulatory structure, which creates an artificial market. I propose a structure that begins with technology transfer obligations, contains mechanisms for quantifying and tracking transfers, and provides accountability through an enforcement mechanism. One model for such a market is the Renewable Energy Credit ("REC") market created by Renewable

154. Enabling Environments, *supra* note 15, at 10.

155. UNFCCC, *supra* note 12, art. 4, ¶ 7.

156. China has made a significant push recently in terms of both Chinese patents and U.S. Patents. *See Battle of ideas, Chinese companies are enforcing patents against foreign firms*, THE ECONOMIST (Apr. 23, 2009), http://www.economist.com/node/13528318.

157. Provided a framework for such sales continues after the expiry of Kyoto.

158. Maskus & Okediji, *supra* note 7, at 20.

Portfolio Standards ("RPS") in the United States.[159]

This system begins with hard goals for renewable energy generation, requiring that a certain percentage of power generation come from renewable sources.[160] In the proposed U.S. federal RPS system, compliance is shown by submitting RECs to the accounting body.[161] RECs are effectively a paper document that represents a certain amount of renewable energy generation.[162] They are typically transferrable and in some instances, they can be held for up to three years.[163]

A Technology Transfer Credit ("TTC") system would have some similarities. Participating countries would be given a TTC for transferring a low-carbon technology to a recipient country. The TNA from the Marrakesh system would need to be modified slightly to become a Technology Capacity Assessment ("TCA") that could be applied to both developed and developing countries. Each country, based on this assessment, would be charged with transferring out a certain amount of technology based on the portfolio of technologies available. If a country has little or no available green technology to transfer, it would have no obligation.

Quantifying TTCs is clearly a more difficult issue than it is with RECs because of the problems with measuring, reporting, and verifying technology transfer, in comparison to simply measuring the power output of a wind turbine. I propose an approach that would mirror a carbon credit system. Credit would be given by showing the difference between the emissions of the Business as Usual ("BAU") technology and the transferred green technology. For example, if a coal-fired power plant, operating under BAU conditions, emitted 500,000 tons of CO_2 annually and a donor country provided a more efficient boiler that allowed the plant to produce the same amount of energy, while emitting only 400,000 tons of CO_2, the donor country would be credited with transferring a technology valued at 100,000 tons of CO_2. Under this system, more effective technologies would be rewarded with larger TTCs and the system would incent technology transfers that would result in the most economically efficient reduction of CO_2.

Under this system, any country can be a technology transfer recipient. All that matters is that the transferred technology is not available in the recipient country and that the technology results in a net decrease of GHG emissions. This will tend to favor countries with low

159. Renewable Electricity Promotion Act of 2010, S. 3813, 111th Cong. (2010).

160. *Id*. at 12.

161. *Id*. at 12-13.

162. *Id*. at 15.

163. *Id*. at 16.

transaction costs, incenting countries to create the Enabling Environments, including favorable IPR environments, discussed above. This will also create an incentive to seek out the countries with technologies that can be updated with the lowest marginal cost per unit of GHG reduction, more likely to be developing countries rather than developed ones. Countries like China, that straddle the line between technology-producing and technology-receiving, will end up with transfer obligations, but China will also benefit because China's large size may allow a single technology transfer to result in a very large CO_2 reduction.

Much like the REC system in the United States, a TTC system must be built with flexibility. The TTCs should be transferrable, allowing countries that produce and transfer large amounts of low-carbon technology to sell their excess credits and conversely to allow countries that fall below their mark to purchase those credits. An additional flexibility mechanism would be an alternative credit system that allows nations to pay a set cost per TTC to cover the gap between their obligation and the amount of TTCs they earn or purchase.[164] This provides a cost control and predictability measure, while contributing to a fund to purchase licenses for further spreading technologies and perhaps to contribute to covering the cost of the system.

Accountability is the key in any of these systems and as such, there must be penalties for failure to comply. Similar to the proposed federal RPS in the United States, the simplest financial penalty would be some multiplier of the alternative credit cost.[165] Under this system, a penalty is only a mechanism of applying pressure and would only be used if a nation fails to purchase alternative credits. In a sense, it is simply a method for making the purchase of alternative credits involuntary and slightly more painful.

While the approaches I have proposed are just a few of many potentially viable options, I believe that any successful system will require stronger IPR regimes in recipient countries, a strong funding mechanism, and a system of accountability. These three elements are necessary to create a robust market that will maximize both the quantity and the quality of green technology transfer.

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164. The U.S. Federal RPS contains an alternative compliance payment with a set price. *Id*. at 19.

165. *Id*. at 17.

VI. CONCLUSION

The understanding of climate change is growing; so too is the human contribution to it. As these two things grow, the need and demand for technologies to combat climate change will grow as well. The framework for a system to spread these technologies and thus broaden their positive impact, has been developing for years. Solid foundations have been laid, recognizing the varying needs, capacities, and obligations of each nation. Nonetheless, further steps are required to maximize the quality and quantity of green technology transfer.

A basic framework and a reliance on altruism is not enough to create the kind of technology transfer necessary to have a meaningful impact on climate change. A functional, robust market must be created to drive green technology transfer. Creating this market will require the international community to successfully address three main challenges: strengthening IPRs in recipient countries, establishing viable funding mechanisms, and creating a system of accountability.

This Note has addressed some of the basic issues with international IPRs and has highlighted a recent funding mechanism. It has proposed a system of accountability modeled on the proposed U.S. Renewable Portfolio Standard. The proposed system is intended to allow flexibility and choice among nations on the means by which the goals are reached, but institutes accountability in reaching the goals.

The real challenge, of course, is not designing a system. The real challenge is getting so many different nations to agree to hold each other accountable (and to be held accountable) for achieving climate change goals. Because climate change is so much less tangible than other international crises, few nations, especially the most powerful ones, feel the pain that is sometimes necessary to spur dramatic action. In the end, it may be less important what the details of the system of accountability are, but rather that such a system exists at all.