MOVING TOWARDS A SUSTAINABLE FUTURE: REPLACING TRIPS WITH A NEW INTERNATIONAL REGIME FOR INTELLECTUAL PROPERTY AND SUSTAINABLE ENERGY TECHNOLOGY TRANSFER

NIKHIL PRADHAN*

* J.D. Candidate, University of Wisconsin Law School, 2014; B.S., Massachusetts Institute of Technology, 2009. I would like to thank the staff of the Wisconsin International Law Journal for their assistance and feedback, Professor Shalanda Baker of the University of San Francisco School of Law for her guidance, and my family for their support.

INTRODUCTION

One of the foremost issues of the twenty-first century is finding a solution to anthropogenic climate change—that which is caused primarily by human activities. International organizations and agreements such as the United Nations Framework Convention on Climate Change ("UNFCCC"), the Intergovernmental Panel on Climate Change ("IPCC"), the World Trade Organization ("WTO"), and the Kyoto Protocol have all created plans and guidelines for addressing climate change. Many of these organizations and their agreements recognize the role that innovation and technology transfer will play to solve climate change. International intellectual property law will be essential in determining how states and corporations finance, implement, and distribute the innovative technologies necessary to create solutions.

Part I of this paper outlines the key problems and potential solutions surrounding transfer of sustainable energy technologies. Part II provides background on TRIPS and the Doha Declaration, particularly how they interact with patent rights, technology transfer, and member states' public health interests. Part III evaluates how these agreements have affected medical technology transfer, then compares medical technologies with sustainable technologies to show that the latter are significantly distinct in their investment requirements. These investment requirements, along with the non-localized nature of climate change issues, suggest that TRIPS alone will not be sufficient to encourage innovation and implementation of sustainable technologies. This paper concludes by outlining a new intellectual property regime for encouraging the development of sustainable technologies that emphasizes long-term investment in developing states.

I. BACKGROUND ON CLIMATE CHANGE AND SUSTAINABLE ENERGY

A. ANTHROPOGENIC EMISSIONS OF GREENHOUSE GASES CREATE A RANGE OF CHANGES TO GLOBAL CLIMATE THAT MAY RESULT IN DEVASTATING LONG-TERM CONSEQUENCES

Scientific studies have established that anthropogenic emissions of greenhouse gases, particularly carbon dioxide,[1] have caused and will continue to cause the Earth's climate to change.[2] "Not surprisingly, the expansion of industrial activities to meet the needs of a rapidly growing and more affluent population has magnified the drain on resources for production and the impacts of pollution associated with industrial wastes."[3]

Climate change has entered the public conscience over the last twenty years, though scientists have long been drawing connections between energy usage and climate damages.[4] Climate change occurs as

1 *See* JEFFERSON W. TESTER ET AL., SUSTAINABLE ENERGY: CHOOSING AMONG OPTIONS 171 (2005) (detailing in Table 4.7 the various greenhouse gases and their "global warming potential," i.e. how much damage they cause relative to carbon dioxide. The various lifetimes of greenhouse gases, before they decompose into inactive agents, causes them to be more or less damaging over time).

2 *See*, *e.g.*, Anita M. Halvorssen, *UNFCCC, the Kyoto Protocol, and the WTO – Brewing Conflicts or are They Mutually Supportive?*, 36 DENV. J. INT'L L. & POL'Y 369, 369–70 (2008) ("In its fourth report published in February of 2007, the IPCC confirmed that greenhouse gases . . . from human activities have 'very likely' (90% probability) caused the increase in temperatures since 1750.").

3 TESTER ET AL., *supra* note 1, at 762.

4 *See id.* at 33 n.6

("In 1776, British physician Percival Pott attributed the high incidence of scrotal cancer among London chimney sweeps to their regular exposure to combustion-derived soot . . . . Supposedly when the King of Denmark learned of Pott's findings, he ordered all Danish chimney sweeps to the balance changes between the amount of energy that enters, is stored in, and exits the Earth's atmosphere.[5] Greenhouse gases alter the amount of energy that the atmosphere stores and the rate at which this energy dissipates, altering the overall balance.[6] The effects of climate change span from changes in average atmospheric temperatures to deforestation to increased levels of diseases such as malaria.[7] Even a five degree change in atmospheric temperature may result in drastic climate change.[8]

Additionally, climate change damages are difficult to control because they occur over various length and time scales, "from millimeters to 10,000 kilometers—and from seconds to more than 100 years."[9] Over this range of scales, damages can span acute respiratory episodes from air pollutants to desertification from climate modification.[10]

The climate change problem is also unique because unlike other environmental issues, solutions may significantly alter the paradigm of global economic activity.[11] For example, "[l]imiting greenhouse gas emissions under [the Kyoto Protocol] requires developed countries to modify their primary economic structures, including making transformations within energy, transportation, manufacturing, agriculture, and investment sectors."[12] Climate change will continue to exacerbate these damages on a global level, requiring global solutions.

---

take daily baths, thereby promulgating one of the earliest energy-related environmental regulations.").

5 *Id.* at 172.

6 *Id.*

7 *See, e.g.*, NICHOLAS STERN, THE ECONOMICS OF CLIMATE CHANGE: THE STERN REVIEW 65, 88 (2007); STEVE VANDERHEIDEN, ATMOSPHERIC JUSTICE: A POLITICAL THEORY OF CLIMATE CHANGE 8 (2008).

8 TESTER ET AL., *supra* note 1, at 175–76. *See also* Halvorssen, *supra* note 2, at 370 ("[e]ven a 3ºC rise in global average temperature would devastate the global environment, place human survival in grave danger, and risk the collapse of the world economy.") (alteration in original) (quoting Erik B. Bluemel, *Unraveling the Global Warming Regime Complex: Competitive Entropy in the Regulation of the Global Public Good*, 155 U. PA. L. REV. 1981, 1983 (2007)) (internal quotation marks omitted).

9 TESTER ET AL., *supra* note 1, at 35.

10 *Id.* at 37.

11 Halvorssen, *supra* note 2, at 377.

12 Cinnamon Carlarne, *The Kyoto Protocol and the WTO: Reconciling Tensions between Free Trade and Environmental Objectives*, 17 COLO. J. INT'L ENVTL. L. & POL'Y 45, 48 (2006).

B. SUSTAINABLE ENERGY TECHNOLOGIES CAN PROVIDE A SOLUTION TO CLIMATE CHANGE BY REDUCING DEPENDENCE ON TECHNOLOGIES THAT CREATE GREENHOUSE GAS EMISSIONS

Energy resource production, distribution, and use are primary drivers for climate change.[13] Policy tools are important on a global level to manage energy-driven climate change because "energy is intimately commingled with the economic vitality and social progress of individual nations and of the world."[14] Fossil fuel energy resources are currently the major source for greenhouse gas emissions. Emissions from energy systems are driven by energy demand from buildings, industry and transport, and energy supply through electricity, refined fuels, and direct fuel delivery.[15]

Fossil fuel scarcity alone will not provide an economic incentive to move towards more sustainable technologies.[16] Therefore, a global framework to address climate change through technology transfer will require new methods to incentivize sustainable technologies.[17] Additionally, this framework will need to fit with the energy demand and supply sources and sinks.[18]

---

[13] *See* TESTER, ET AL., *supra* note 1, at 33 (showing in Figure 1.15 the sources and end uses of electricity in the United States for 2001). *See also id.* at 36–37 (detailing in Table 1.6 various examples of environmental and other hazards of various energy supply technologies, across a variety of damage types).

[14] *Id.* at 24.

[15] Michael Grubb, *Technology Innovation and Climate Change Policy: an overview of issues and options*, 41 KEIO ECONOMIC STUDIES, no. 2, 2004, at 104.

[16] TESTER ET AL., *supra* note 1, at 82–83
("It is unclear whether sustained persistence of low oil prices is good or bad for sustainable development. Some experts believe that low prices harm conservation efforts and are a significant disincentive to consumers to adopt alternative technologies, especially renewables. However, low oil prices are a proven source of economic vitality for developed and developing nations. Some argue that low oil prices are a means to protect the environment and achieve the diverse goals of sustainable development, including stewardship of all the earth's natural resources—water, minerals, forests, arable land, open space, recreational areas, and energy—while maintaining and extending economic opportunity.").

[17] *See, e.g.*, GARY P. SAMPSON, THE WTO AND SUSTAINABLE DEVELOPMENT 37 (2005)
("Clarifying the role of the WTO in matters relating to sustainable development is an absolute priority for the international community if the enormous contribution that the multilateral trading system has made to world economic growth and stability over the past 50 years is to continue for the next half-century and beyond.").

[18] *See* Grubb, *supra* note 15, at 104–05.

C. GENERAL PARADIGMS FOR ADDRESSING CLIMATE CHANGE ISSUES PROVIDE A FRAMEWORK FROM WHICH TO BUILD A SOLUTION THAT EMPHASIZES SUSTAINABLE ENERGY TECHNOLOGY TRANSFER AND DEVELOPMENT

A variety of paradigms exist to address the systemic developments that may be necessary to solve climate change.[19] These paradigms represent different solutions to the cost-benefit balance that climate change requires. From most to least extreme relative to the status quo, they include radical ecology, deep ecology, industrial ecology, and continuation of the status quo, also known as 'business-as-usual.'[20] First, radical ecology argues for a return to low technology, but may result in an unmanaged population crash because of the sharp decrease in resources, as well as economic, technological, and cultural disruption.[21] Second, deep ecology argues for appropriate technology, and encourages "low tech" where possible. Deep ecology may result in lower populations and substantial adjustments to economic, technological, and cultural status quo.[22]

Third, industrial ecology argues for reliance upon technological evolution within environmental constraints.[23] It does not specifically encourage the use of "low" technologies unless they are environmentally preferable or a better match to ambient socio-economics. Industrial ecology may result in moderately higher populations because global resources should continue to grow.[24] It may also result in substantial adjustments to economic, technological, and cultural status quo.[25]

Fourth, continuation of the status quo, a form of a *laissez faire* paradigm, argues for ad hoc adoption of specific mandates (e.g., CFC ban) but with little effect upon overall trends.[26] This paradigm may result in unmanaged population crash, with economic, technological, and cultural disruptions.[27]

---

19 TESTER ET AL., *supra* note 1, at 42.
20 *Id.*
21 *Id.*
22 *Id.*
23 *Id.*
24 *Id.*
25 *Id.*
26 *Id.*
27 *Id.*

The four paradigms explained here represent high-level abstract models for how the global economy may shift over time in response to climate change. The next section will focus on more specific tools to address climate change in an international context. These tools could be implemented within any of the abstract paradigms presented here.

D. INTERNATIONAL COOPERATION AND LOCAL-LEVEL PARADIGMS THAT PROMOTE TECHNOLOGY INNOVATION AND TRANSFER THROUGH INTELLECTUAL PROPERTY ARE BOTH NECESSARY TO ADDRESS CLIMATE CHANGE

A broad portfolio of new technologies that minimize the emission of greenhouse gases and mitigate the damage they cause ("sustainable technologies") are needed to combat climate change, and these technologies will need to be introduced on a global scale.[28] One approach for implementation divides the emissions gap into seven "wedges," each of which provides a manageable unit that permits "quantitative discussion of cost, pace, and risk."[29]

This divide-and-conquer approach is useful because wedges may range from improvements in efficiency for automobiles to implementation of nuclear and renewable energy to effective forest and soil management.[30] For example, two different wedges to reduce the use of coal power could be "a million two-megawatt wind turbines . . . [or] capturing and storing the carbon produced in 800 large modern coal plants."[31] Nevertheless, each wedge is difficult to accomplish because "huge scale-up is required, and scale-up introduces environmental and social problems not present at limited scale."

International organizations are already working to facilitate cooperation among states that will drive adoption of wedges and sustainable technology development. The UN has taken a leading role in promoting sustainable technologies. The UN defines sustainable technologies as: "technologies [that] protect the environment, are less polluting, use all resources in a more sustainable manner, recycle more

---

[28] Edna Sussman, *A Multilateral Energy Sector Investment Treaty: Is it Time for a Call for Adoption by All Nations?*, 44 INT'L LAW. 939, 939 (2010).

[29] The emissions gap refers to replacing greenhouse gas-emitting technologies that would create increased emissions over time in a business-as-usual scenario with sustainable technologies. *See* Grubb, *supra* note 15, at 107.

[30] *Id.* at 107–08.

[31] *Id.*

of their wastes and products, and handle residual wastes in a more acceptable manner than the technologies for which they were substitutes."[32] The United Nations Framework Convention on Climate Change ("UNFCCC"), is a significant governing instrument that the UN uses to address climate change and technology transfer. This treaty, which binds the United States, "enshrines the principle of 'common but differentiated responsibilities' for climate policymaking and puts forward a goal of minimizing the adverse effects on an economy of measures to mitigate or adapt to climate change."[33]

The UNFCCC states its objective as:

> [S]tabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.[34]

Further, the UNFCCC states that developed states are to "promote, facilitate, and finance, as appropriate, the transfer of, or access to," environmentally sound technologies, in particular to developing countries.[35]

Perhaps the most significant treaty for climate change is the UNFCCC's Kyoto Protocol. "Kyoto, more than any existing [Multilateral Environmental Agreement], is likely to impact state economies and international trade relations."[36] Kyoto promotes the UNFCCC's objective by creating "legally binding obligations for

---

32 United Nations Conference on Environment and Development, Rio de Janeiro, Braz., June 3–14, 1992, *Agenda 21–Chapter 34: Transfer of Environmentally Sound Technology, Cooperation and Capacity-Building*, at 34.1, *available at* http://sustainabledevelopment.un.org/content/documents/Agenda21.pdf. *See also* TESTER ET AL., *supra* note 1, at 280–82 (describing various indicators of sustainability, including environmental, economic, and social sustainability).

33 Steve Charnovitz, *Trade and Climate Change: Reviewing Carbon Charges and Free Allowances Under Environmental Law and Principles*, 16 ILSA J. INT'L & COMP. L. 395, 401 (2010). *See also* Carlarne, *supra* note 12, at 46 ("Increasingly, multilateral environmental agreements (MEAs) rely on trade measures to implement and to enforce environmental obligations.").

34 Halvorssen, *supra* note 2, at 372 (alteration in original) (citation omitted).

35 Alexander Adam, *Technology Transfer to Combat Climate Change: Opportunities and Obligations under TRIPS and Kyoto*, 9 J. High Tech. L. 1, 12 (2009) (citation omitted) (internal quotation marks omitted).

36 Carlarne, *supra* note 12, at 47.

developed countries that require them to gradually reduce human-induced greenhouse gas emissions to an average of 5.2 percent below their 1990 emission levels."[37]

In addition to international cooperation, technological innovation is also essential to stabilizing and reducing greenhouse gases. Research and development "targets increased utilization efficiency and decreased environmental footprint."[38] New technologies that are potentially sustainable require large capital costs for research and development.[39] Therefore, because of the relationship between intellectual property rights and research and development, the international community requires a cooperative system for regulating intellectual property that both encourages innovation and facilitates distribution of technology—that is, technology transfer.[40]

The main steps in the innovation chain can be divided into those on the supply side and those on the demand side. Supply-side steps involve product and technology "pushing," spanning from basic research and development to technology-focused research and development to market demonstration.[41] Demand-side steps involve market "pulling" and range from commercialization to market accumulation to diffusion to customers.[42]

Technology transfer represents the process by which technologies throughout the innovation chain are moved across borders and industries. More specifically, the IPCC has defined 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

---

37 *Id.*

38 TESTER ET AL., *supra* note 1, at 353.

39 *See id.* at 444 (explaining how research and development is still required to overcome sustainability issues for biomass production technologies). *See also* Cymie Payne, *Local Meets Global: The Low Carbon Standard and the WTO*, 34 N.C. J. INT'L L. & COM. REG. 891, 892 (2009) ("Regulations to ensure that biofuels are truly low carbon transportation fuels test the potential of our transnational legal system.").

40 *See* Carl Bruch & John Pendergrass, *Type II Partnerships, International Law, and the Commons*, 15 GEO. INT'L ENVTL. L. REV. 855, 855 (2003) (arguing that international solutions require mutual coercion mutually agreed upon). *See also* Timothy A. Canova, *International Law Confronts the Global Economy: Labor Rights, Human Rights, and Democracy in Distress*, 8 CHAP. L. REV. 1, 13 (2005) ("The search for solutions to the world's energy deficits requires an inventory of resources, new and emerging technologies, and institutional capabilities.").

41 *See* Grubb, *supra* note 15, at 109–10.

42 *See id.*

("NGOs"), and research/education institutions."[43] This kind of technology transfer is important because it will lead to energy supply security on a distributed level. For example, "forty-two African countries are net oil importers. This makes them particularly vulnerable to volatility in global fuel prices and dependent on foreign exchange to cover their domestic energy needs."[44] Transferring sustainable technologies would allow such countries to hedge against volatile fuel prices, leading to energy security. In turn, energy security represents one method for states to reduce reliance on fossil fuels to meet energy demand. Further, the vast geographic scope of this energy security issue for Africa illustrates the need for international cooperation to support the necessary technology transfer.

E. INTERNATIONAL COOPERATION IS NECESSARY FOR SUSTAINABLE ENERGY TECHNOLOGY TRANSFER, THOUGH DIVERGENCE IN THE GOALS OF VARIOUS PARTIES INTRODUCES MAJOR COOPERATION COSTS

Global leadership in developed countries recognizes the climate change problem and the role that these states must play in creating solutions.[45] Further, solutions to climate change require a large scope that includes social and economic criteria, rather than just carbon-consciousness.[46] To facilitate lasting change, sustainability proponents must consider the practical political reality, globalization of commerce and more democratic ideals, environmental stewardship, and constructive engagement.[47]

---

[43] Intergovernmental Panel on Climate Change [IPCC], *IPCC Special Report: Methodological and Technological Issues in Technology Transfer–Summary for Policymakers*, 3 (2000), *available at* http://www.ipcc.ch/pdf/special-reports/spm/srtt-en.pdf [hereinafter IPCC Report].

[44] B. Amigun & H. von Blottnitz, *Operating Cost Analysis of an Annexed Ethanol Distillery in a Rural, Landlocked African Country*, 30 ENVTL. PROGRESS & SUSTAINABLE ENERGY 500, 500 (2011). *See also infra* Part I.E. (discussing energy diversification).

[45] *See, e.g.*, U.N. Global Compact, *G8 Gleneagles Communique: Climate Change, Energy, and Sustainable Development*, 1–10 (2005), *available at* http://www.unglobalcompact.org/docs/about_the_gc/government_support/PostG8_Gleneagles_Communique.pdf. *See also* Marina Medved, *Potential Environmental Impacts of Central America Free Trade Agreement-Dominican Republic*, 13 NEW ENG. J. INT'L & COMP. L. 74, 74 (2006) ("The International Court of Justice . . . recognizes a state's international duty to protect the environment.").

[46] Jody M. Endres, *Clearing the Air: The Meta-Standard Approach to Ensuring Biofuels Environmental and Social Sustainability*, 28 VA. ENVTL. L.J. 73, 73 (2010).

[47] TESTER ET AL., *supra* note 1, at 44.

The divergence between the goals of states in different stages of development also underscores the need to evaluate climate change solutions based on these diverse criteria.[48] States with high energy consumption per capita also tend to be major consumers of fossil fuels.[49] As such,

> [d]eveloping nations aspiring to the economic growth enabled in the developed countries by "cheap" fossil energy have little interest in adopting more expensive non-fossil alternatives without financing from the developed world. The issue is one of equitable treatment in which emerging economies desire to move rapidly to attain some of the socioeconomic benefits identified with their developed neighbors.[50]

Conflicts between states at either end of the development spectrum may unnecessarily increase the costs of adopting sustainable technologies.[51] Equity concerns will control climate change regime development for two reasons. First, "[t]he developing countries, like India and China, quite rightly point out that burden-sharing formulas in the climate regime need to take into account the historical responsibility for GHG emissions by the industrial countries."[52] Second, "[t]here is also a significant issue of intergenerational equity, namely, how much mitigation should occur now even though technological improvements may make mitigation less expensive in the future."[53]

Furthermore, the strong correlation between the human development index and electricity usage per capita suggests that states require large amounts of energy consumption to assure a viable standard

---

48 *See, e.g.*, *id.* at 26.

49 *See id.* at 337.

50 *Id.* at 339.

51 *See id.* at 340. *See also* Charnovitz, *supra* note 33, at 408 (describing the tension between the OECD Principle of 1974 and the UNFCCC Principle of 1992, because they place different obligations on developing countries, as a reflection of the "vague" concept of common but differentiated responsibilities); Grubb, *supra* note 15, at 126 ("Some of the institutional problems in public R&D may be amplified in the context of international technology program[]s, where the goal of cooperation among countries is bedeviled by unavoidable issues of international rivalry. Every government would like its own industry / technology to receive support from international sources, especially if there is a significant prospect of it delivering commercial success, and is reluctant to spend on technologies of other countries.").

52 Charnovitz, *supra* note 33, at 398.

53 *Id.* at 398–99.

of living.[54] Current divergence in standard of living between developed and least-developed countries,[55] and each group's goals vis-à-vis the status quo, may introduce further cooperation costs.[56] Developed countries (and their citizens) will want to maintain their standard of living, if not continue their growth, while least-developed countries want to reach the high standard of living as fast as possible.[57]

Divergence between the United States' goals and the EU's also may cause additional trade costs.[58] In 2007, Jacques Chirac "described the use of a European carbon tax as 'inevitable' and has threatened to level the playing field with an additional border tax on imports from countries that don't join the Protocol."[59] Even though the United States is not a party to the Kyoto Protocol, "US policy analysts have similarly suggested that if their government puts in place caps on greenhouse gas emissions, import licenses for energy intensive goods from countries without similar caps would be made conditional on surrendering carbon offsets equivalent to the emissions expended in the production of those goods."[60]

In addition, key nations including China are in critical periods where they must avoid the "pollute during the industrialization phase and clean up later" mentality.[61] This mentality poses two problems. First, it pushes the costs of climate change damages onto other states, making it more expensive for these states to devote resources to technology

---

54 TESTER ET AL., *supra* note 1, at 265–66.

55 Categories such as "developed," "developing," and "least-developed" generally refer to a state's economic development. *See* U.N. Statistics Division, Composition of Macro Geographical (Continental) Regions, Geographical Sub-regions, and Selected Economic and Other Groupings, (revised Feb. 11, 2013), http://unstats.un.org/unsd/methods/m49/m49regin.htm (grouping states into developed regions, developing regions, least developed countries, landlocked developing countries, Small island developing States, and Transition countries).

56 TESTER ET AL., *supra* note 1, at 266–67 (connecting the correlation between human development index and electricity usage with least-developed countries' desire to increase their standard of living through increased energy usage). *See also supra* text accompanying note 51.

57 *See also supra* text accompanying note 51.

58 *See* Halvorssen, *supra* note 2, at 378 (explaining how the EU may apply various costs, including border taxes or emissions taxes, on products imported from the United States, because American companies are not bound by the Kyoto Protocol and thus have a competitive advantage over European countries).

59 *See* Jacob Werksman, Book Review, 25 BERKELEY J. INT'L L. 459, 473 (2007) (reviewing Rary Sampson, The World Trade Organization and Sustainable Development (2005)) (citing Eric Kane, *Chirac Renews Call for Carbon Tax on US*, TREEHUGGER (Feb. 5, 2007), http://www.treehugger.com/files/2007/02/chirac_renews_c.php).

60 *Id.*

61 NOUREDDINE BERRAH ET AL., SUSTAINABLE ENERGY IN CHINA: THE CLOSING WINDOW OF OPPORTUNITY, at xxxviii (2007).

development. This would also reduce moral incentives for smaller developing states to enter global agreements for climate change. Second, this mentality can accelerate the costs of climate change damages and mitigation, as feedback effects from current emissions make it more difficult to repair existing damage.

Therefore, policy tools are a major factor for successful implementation of sustainable technologies that will create real solutions to the climate change problem. The default tendency to arbitrarily throw technology at social problems—including for energy-related problems—often has mixed results at best.[62] Policy tools that encourage sustainable energy create solutions to climate change by reducing, for example, the carbon intensity of the energy system, thus reducing greenhouse gas emissions.[63] These tools may be punitive, may consist of minimum standards for energy usage, and/or may be financial, such as taxes on carbon usage or energy consumption.[64]

Market-based policy tools, such as a cap-and-trade program, can be successful to reduce greenhouse gas emissions by moving emissions to only those entities with low marginal costs, while reducing total emissions.[65] The "cap" component needs to be strictly enforced because this will make carbon dioxide credits scarcer and thus more valuable. Scarce, expensive credits provide a strong incentive for business to substitute away from carbon-intensive processes, and thus avoid the cost of purchasing credits.[66] An effective cap-and-trade program will best function in a free market system that encourages trade liberalization.[67] Trade liberalization provides its own benefits for global sustainable development and standards of living, and will compound the benefits of an effective climate change solution regime.[68]

Another unique program that provides policy tools is the Kyoto Protocol's Climate Development Mechanism ("CDM"). Theoretically,

---

62 Robert W. Fri, *The role of knowledge: Technological Innovation in the energy system*, 24 THE ENERGY J., no. 4, 2003 at 51, 60–63.

63 TESTER ET AL., *supra* note 1, at 181.

64 *Id.* at 181, 200–02.

65 *Id.* at 200–02 (explaining how the United States' program for trading sulfur dioxide allowances, a part of the 1990 Clean Air Act, successfully combated acid rain).

66 *See* Halvorssen, *supra* note 2, at 373.

67 *See id.* at 373–74.

68 *See* Werksman, *supra* note 59, at 463 (citing World Bank analysis "suggesting that liberalization of merchandise trade, accompanied by appropriate domestic policies would lead to a 5% growth in developing country income and lift 300 million people out of extreme poverty in the coming decade.").

CDM promotes foreign direct investment ("FDI")[69] because it encourages developed nations to carry out projects that reduce greenhouse gas emissions in developing countries in return for emissions credits at home.[70] However, it is unclear if the CDM will continue if Kyoto or similar international agreements sunset.

Additionally, energy diversification is a valuable policy strategy because, like investment diversification, it increases a state's energy supply security by making the state more resilient to supply shocks.[71] Energy diversification can reduce dependence on petroleum-based resources and stimulate domestic economies.[72] A diverse portfolio might include "increased focus on end-use energy efficiency, low emission or low-carbon technologies such as renewable sources, nuclear energy (with adequate security and safety measures), and, most importantly, clean-coal technologies—preparing, wherever possible, for carbon dioxide sequestration."[73]

[69] Foreign direct investment provides a method for capital to flow from corporations in developed states in order to fund large projects. *See Foreign Direct Investment, Net Inflows*, THE WORLD BANK, http://data.worldbank.org/indicator/BX.KLT.DINV.CD.WD (last visited Mar. 11, 2012) ("Foreign direct investment are the net inflows of investment to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments.").

[70] *Clean Development Mechanism (CDM)*, UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE, http://unfccc.int/kyoto_protocol/mechanisms/clean_development_mechanism/items/2718.php (last visited Apr. 2, 2013).

[71] *See, e.g.*, Daniel Yergin, *Ensuring Energy Security*, FOREIGN AFF., Mar.–Apr. 2006, at 69, 82; ZHANG JIAN, THE BROOKINGS INSTITUTION CENTER FOR NORTHEAST ASIAN POLICY STUDIES, CHINA'S ENERGY SECURITY: PROSPECTS, CHALLENGES, AND OPPORTUNITIES 2 (2011), *available at* http://www.brookings.edu/~/media/Files/rc/papers/2011/07_china_energy_zhang/07_china_energy_zhang_paper.pdf; Gail Cohen et al., Measuring Energy Security: Trends in the Diversification of Oil and Natural Gas Supplies 3–4 (July 2011) (Int'l Monetary Fund Working Paper), *available at* http://www.imf.org/external/pubs/ft/wp/2011/wp1139.pdf.

[72] Sasha Glassman, *Proposed Amendments to Multilateral Trading Agreements to Encourage U.S.-Mexico Trade in Biofuels*, 17 U. BALT. J. ENVTL. L. 107, 107 (2010); Sean Charles Starr, Comment, *Sweet Rewards: How U.S. Trade Liberalization and Penetration of Brazilian Ethanol into the U.S. Market Can Stimulate America's Domestic Economy and Strengthen America's International Influence*, 8 DEPAUL BUS. & COM. L.J. 275, 277 (2010).

[73] BERRAH ET AL., *supra* note 61, at xxxviii.

F. TECHNOLOGY-PUSH AND DEMAND-PULL PARADIGMS MAY BOTH BE VALUABLE FOR PROMOTING SUSTAINABLE TECHNOLOGY DEVELOPMENT AND TRANSFER

The technology-push paradigm emphasizes

> development of low-GHG technologies, typically through publicly funded R&D programmes, rather than regulatory limitations on emissions . . . . It would be preferable to concentrate in the near term on investing in technological innovation, and adopt emissions limitations later when innovation has lowered the costs of limiting GHG emissions, rather than mandating costly reductions now.[74]

Technology-push may be especially valuable in the fast-developing countries with strong industrial bases, such as China, India, and Brazil.[75] These nations may have lower costs for introducing innovative sustainable technologies because they have newer infrastructure for energy production and transmission, and do not have to replace or build over older infrastructure in order to connect sustainable technologies to the grid.[76]

Transportation infrastructure is an especially significant consideration for the costs of climate change mitigation because transportation requires significant energy consumption, and because most fossil fuel resources must be transported great distances to the major energy consuming states.[77] At the same time, nations like China have massive energy demands that are growing very quickly, making it extremely important to increase energy supply by introducing sustainable technologies to meet these demands.[78]

The demand-pull paradigm argues that technological change must come from the business sector and is primarily a product of economic incentives.[79] The goal of economic incentives is to create a need for private industry to improve their technologies in order to take advantage of economic incentives (or alternatively, to avoid losses by

---

74 Grubb, *supra* note 15, at 109.

75 *See* BERRAH ET AL., *supra* note 61, at xlv.

76 *See generally* NANDAN NILEKANI, IMAGINING INDIA *passim* (2008).

77 *See, e.g.*, Payne, *supra* note 39, at 894 ("Transportation contributes about forty percent to California's total GHG emissions.").

78 *See* BERRAH ET AL., *supra* note 61, at xlv.

79 Grubb, *supra* note 15, at 109.

blocking disincentives).[80] Essentially, demand-pull reduces the marginal cost of using sustainable technologies, and/or increases the marginal cost of using carbon-intensive and energy-intensive technologies. Examples of economic incentives include technology-based regulatory limitations including tax incentives, greenhouse gas emission caps, and charges tied to emissions levels.[81]

Together, these theories, paradigms, and models for sustainable energy technology transfer frame potential solutions for climate change. The solutions will require international cooperation to move towards energy security using adoption of "wedges," through diversification and a reduced dependence on technologies that create greenhouse gas emissions. In addition, intellectual property agreements will be necessary to facilitate sustainable energy technology transfer.

II. THE GLOBAL INTELLECTUAL PROPERTY REGIME: TRIPS AND THE DOHA DECLARATION

The WTO's TRIPS provides a normative framework for state protection of intellectual property. Sustainable development is one of the objectives of the WTO Agreement.[82] The WTO's TRIPS establishes a framework for WTO member states to regulate intellectual property, with the dual goals of innovation and technology distribution as its primary objective.[83] Intellectual property agreements generally, and TRIPS in particular, are important for solving climate change because they create pathways between states, and eventually private corporations, for sustainable energy technology transfer.

A. PATENT PROTECTION, LICENSING, AND EXHAUSTION UNDER TRIPS

Of special relevance to sustainable technology innovations are TRIPS's provisions on patents. TRIPS does not protect or grant patents

---

80 *Id.*

81 T.M.L. Wigley et al., *Economic and environmental choices in the stabilization of atmospheric CO2 concentrations*, 379 NATURE 240, 240–43 (1996).

82 Charnovitz, *supra* note 33, at 402.

83 Agreement on Trade Related Intellectual Property Rights art. 7, Apr. 15, 1994, Marrakesh Agreement Establishing the World Trade Organization, Annex 1C, THE LEGAL TEXTS: THE RESULTS OF THE URUGUAY ROUND OF MULTILATERAL TRADE NEGOTIATIONS 320 (1999), 1869 U.N.T.S. 299, 33 I.L.M. 1197 (1994) [hereinafter TRIPS].

by itself; rather, it establishes guidelines for member states to follow through their local systems.[84] Generally, member states must make patents available in their jurisdiction for inventions that are new, non-obvious or involve an inventive step, and useful or industrially applicable.[85] Member states may also exclude inventions from patentability if doing so would be necessary to protect public order or morality, including protection of human, animal, or plant life or health, or to avoid serious prejudice to the environment.[86]

TRIPS member states may also grant exceptions to the otherwise exclusive rights that patents grant, as long as these exceptions "do not unreasonably conflict with a normal exploitation of the patent and do not unreasonably prejudice the legitimate interests of the patent owner, taking account of the legitimate interests of third parties."[87] In addition, there are exceptions to patent protection for the purposes of research and experimental use.[88]

TRIPS also permits compulsory licensing, which allows member states to license technologies even if reasonable efforts to negotiate licensing are not successful.[89] Compulsory licensing has been one of the primary drivers for diffusion of medical technologies following the Doha Declaration.[90] Ideally, compulsory licensing fulfills the goals of both TRIPS and patent holders by disseminating medical technologies while returning monetary value to the patent holder.

In addition, TRIPS does not require member states to choose a position on the doctrine of exhaustion.[91] Exhaustion means that once the owner of an invention's intellectual property rights consents to marketing the invention in a certain jurisdiction, the owner's control over the invention is exhausted.[92] Therefore, if an American pharmaceutical company sold a drug in France, a third-party state could then purchase

---

84 *Id.* art. 27.

85 *Id.* art. 27, ¶ 1.

86 *Id.* art. 27, ¶ 2.

87 *Id.* art. 30.

88 Joint United Nations Programme on HIV/AIDS [UNAIDS], *Technical Brief: Doha+10 TRIPS Flexibilities and Access to Antiretroviral Therapy: Lessons from the Past, Opportunities for the Future*, at 8, UNAIDS Doc. JC2260E (Nov. 2011), *available at* http://www.unaids.org/en/media/unaids/contentassets/documents/unaidspublication/2011/JC2260_DOHA+10TRIPS_en.pdf [hereinafter UNAIDS].

89 *See* TRIPS, *supra* note 83, art. 31.

90 *See* UNAIDS, *supra* note 88, at 13.

91 *See* TRIPS, *supra* note 83, art. 31.

92 *See* UNAIDS, *supra* note 88, at 8.

the drug in France and sell the drug in its local market without infringing on the original patent. Further, a member state's choice of actions with regards to exhaustion cannot be challenged under the WTO's dispute settlement system.[93]

B. TECHNOLOGY TRANSFER

TRIPS also explicitly outlines strategies to promote technology transfer from developed countries to least-developed countries.[94] TRIPS does not provide a unified, formal definition for technology transfer, so member states may provide their own definitions.[95] For example,

> [u]sing the United Nations definition, New Zealand sees four key modes of technology transfer: (i) physical objects or equipment; (ii) skills and human aspects of technology management and learning; (iii) designs and blueprints which constitute the document-embodied knowledge on information and technology; and (iv) production arrangement linkages within which technology is operated.[96]

Each of these modes is critical for sustainable energy technology transfer. Physical equipment provides the base for the large energy projects necessary to support growing energy needs, and often requires massive capital outlays. Skill development is crucial for operating energy projects, and also for creating independence for least-developed countries to create and manage projects on their own. Document-embodied knowledge connects the intellectual property wealth of developed states to the human capital in least-developed states. Production arrangement linkages underlie the infrastructure development necessary to bring the product of energy technologies to end-users.

TRIPS creates a positive legal obligation for developed countries to drive technology transfer: "[d]eveloped country Members *shall* provide incentives to enterprises and institutions in their territories for

---

93 *See* TRIPS, *supra* note 83, art. 6.

94 *Id.* arts. 66–67.

95 Suerie Moon, Int'l Cent. for Trade & Sustainable Dev. [ICTSD], *Does TRIPS Art. 66.2 Encourage Technology Transfer to the LDCs? An Analysis of Country Submissions to the TRIPS Council (1999–2007)*, at 3, Policy Brief No. 2 (Dec. 2008), *available at* http://ictsd.org/downloads/2009/03/final-suerie-moon-version.pdf. Failing to reach a unified definition creates its own problems, as member states may appear to meet their obligations under TRIPS by applying an overly broad definition to their actions. *Id.* at 3.

96 *Id.* (citation omitted).

the purpose of promoting and encouraging technology transfer to least-developed country Members in order to enable them to create a sound and viable technological base."[97] Further, TRIPS recognizes that legal tools play a significant role in technical cooperation. "[D]eveloped country Members shall provide, on request and on mutually agreed terms and conditions, technical and financial cooperation in favour of developing and least-developed country Members."[98] In recognition of the different challenges facing developed and least-developed states, TRIPS provides flexible, long-term target timelines for least-developed countries to comply with TRIPS.[99]

C. THE DOHA DECLARATION CLARIFIES THAT TRIPS DOES NOT INTERFERE WITH MEMBER STATES' ABILITY TO PROTECT PUBLIC HEALTH INTERESTS

The 2001 Doha Declaration emphasized that TRIPS does not prevent member states from taking necessary steps to protect public health.[100] States should also be able to apply the public health goal to climate change issues because climate change damages can affect diseases, agricultural resources, and water supply and quality, among other consequences. Although the Doha Declaration primarily applies to existing issues surrounding diseases and public health, these issues also directly implicate climate change because climate change will exacerbate damages from diseases.[101]

Licensing of medicines in South Africa[102] and Brazil[103] has shown that states all along the development spectrum can act within the scope of TRIPS and the Doha Declaration to promote the goals of innovation and technology distribution. However, the balance between

---

97 TRIPS, *supra* note 83, art. 66, ¶ 2 (emphasis added).

98 *Id.* art. 67.

99 *See, e.g.*, *id.* art. 66, ¶ 1.

100 World Trade Organization, Ministerial Declaration of 14 November 2001, WT/MIN(01)DEC/1, 41 I.L.M. 746, ¶ 17 (2002) [hereinafter Doha Declaration]. For a detailed background on TRIPS and the Doha Declaration, see WORLD TRADE ORGANIZATION, A HANDBOOK ON THE WTO TRIPS AGREEMENT (Antony Taubman et al. eds., 2012).

101 STERN, *supra* note 7, at 74–77.

102 Press Release, GlaxoSmithKline, GSK Announces New Commitments to Fight HIV/AIDS in Sub-Saharan Africa – Special Focus on Care and Treatment of Children (July 14, 2009), *available at* http://us.gsk.com/html/media-news/pressreleases/2009/2009_pressrelease_10073.htm.

103 *See, e.g.*, Vera Zolotaryova, *Are We There Yet? Taking "TRIPS" to Brazil and Expanding Access to HIV/AIDS Medication*, 33 BROOKLYN J. INT'L L. 1099, 1099 (2008).

intellectual property rights and access to medicines is still unsettled and continues to develop.[104]

The structure and goals of TRIPS and the Doha Declaration show how intellectual property helps drive technology transfer. The following section will detail the role these agreements have played in driving medical technology transfer, and compare this to the role intellectual property agreements may play in sustainable energy technology transfer.

III. COMPARISON OF TRIPS AND DOHA FOR MEDICAL AND SUSTAINABLE TECHNOLOGIES

Sustainable technologies have both significant similarities and differences to medical technologies. Both of these sets of technologies address problems that cross international boundaries and require international solutions.[105]

A. SIMILARITIES BETWEEN MEDICAL AND SUSTAINABLE TECHNOLOGIES

Access to medicine and climate change mitigation are both public goods that are non-rival in consumption.[106] One person's use of a medicine does not significantly affect the total supply of that medicine for others to use; similarly, one person's access to electricity from a power plant does not significant limit anyone else's access to that electricity.

---

[104] Angelina Yearick Heimel, Comment, *The Power of a Patent: The Impact of Intellectual Property Protections in the Free Trade Area of the Americas Agreement on the Plight of Prescription Drug Availability and Affordability in Central and South America*, 16 PACE INT'L L. REV. 447, 448 (2004).

[105] Jayashree Watal, Counsellor, Intellectual Property Division, WTO, Address at the University of Copenhagen Faculty of Law Webcast: Trade, Technology and Climate Change Linkages: The Current Debate (Dec. 12, 2009), *available at* http://jura.ku.dk/english/webcast_wto/ (follow "Jayashree Watal Counsellor Intellectual Property Division WTO" hyperlink). *See also* Nicholas A. Robinson, *Befogged Vision: International Environmental Governance a Decade after Rio*, 27 WM. & MARY ENVTL. L. & POL'Y REV. 299, 360 (2002) ("It would be in the interests of all nations to encourage . . . regional cooperation as the future foundation[] for international environmental governance institutions."); Charles E. Di Leva, *Sustainable Development and the World Bank's Millennium Development Goals*, NAT. RESOURCES & ENV'T, Fall 2004, at 13, 13 (2004) (noting the cross-border aspects of the Millennium Development Goals).

[106] Jayashree Watal Webcast Address, *supra* note 105.

Patents are an effective tool for encouraging the development of these technologies.[107] Medical technologies depend significantly on research and development in order to reach the marketplace and become public goods. Innovative sustainable technologies also require novel engineering solutions to become economically viable, even if the basic concepts are in the public domain. Trade in the international community is essential to resolving these issues for developed and developing countries.[108] Cooperation between government and industry is also essential.[109]

B. ORGANIZATIONAL DIFFERENCES BETWEEN MEDICAL TECHNOLOGIES AND SUSTAINABLE TECHNOLOGIES

Climate change mitigation requires a concerted effort on a global level in order to be effective, because greenhouse gas emissions are not localized to the state that causes them.[110] Carbon leakage may occur if emissions-causing industries are shifted to regions with lenient emissions standards.[111] Leakage typically is characterized negatively because it may undo the benefits that states with effective emissions standards do create.[112] However, "one should recall that leakage can be efficient if GHG-intensive production moves to another country where the same goods can be produced in a more carbon friendly way, for example, with hydropower."[113]

In addition, incremental efforts, whereby each state determines its own climate change mitigation policy, may actually frustrate the global effort.[114] Though the decentralized approach has its merits, this

---

[107] Jayashree Watal Webcast Address, *supra* note 105.

[108] Dennis J. Hough, Jr., *World Trade Organization Agreements and Principles as a Vehicle for the Attainment of Energy Security*, 9 RICH. J. GLOBAL L. & BUS. 199, 226–27 (2010).

[109] Mark E. Rosen, *Energy Independence and Climate Change: the Economic and National Security Consequences of Failing to Act*, 44 U. RICH. L. REV. 977, 1044 (2010).

[110] Jayashree Watal Webcast Address, *supra* note 105.

[111] *Id.*

[112] Charnovitz, *supra* note 33, at 399.

[113] *Id.*

[114] Jayashree Watal Webcast Address, *supra* note 105. *See also* Lawrence A. Kogan, *Brazil's IP Opportunism Threatens U.S. Private Property Rights*, 38 U. MIAMI INTER-AM. L. REV. 1, 136–37 (2006) (highlighting Brazil's growth as an emerging economy and aspiring regional and global power, but one that may seek sustainable development that eschews strong intellectual property rights).

approach fails to address localization and leakage issues without a top-down policy to complement it.[115]

C. ECONOMIC DIFFERENCES BETWEEN MEDICAL TECHNOLOGIES AND SUSTAINABLE TECHNOLOGIES

1. CAPITAL INVESTMENT PROCESS

Unlike medical technologies, which primarily require an initial capital outlay, sustainable technologies have significant costs distributed throughout their life cycle, from research and development to materials and construction to after-sales services.[116] For example, low-temperature geothermal energy is increasingly being driven by technology, rather than initial capital investment.

> What has been of particular interest recently is that new applications based on innovative technologies with greater efficiency at low-temperature resources have started to emerge. This is extremely important because of three main reasons. First, the abundance of geothermal resources worldwide is heavily skewed toward the low-temperature end. Second, the low-temperature resource and the potential for utilization are typically ubiquitous over a given area, thus allowing the resource to be used within a given preexisting planning boundary, such as a city. Consequently, this type of resource does not require massive infrastructural investment in capital (such as transmission lines, distribution centers and feeders, and necessary maintenance) for usage.[117]

Additionally, many of these considerations emphasize how geothermal energy "is already commercially competitive in many locations worldwide where high-grade hydrothermal resources are found."[118]

---

115 Jayashree Watal Webcast Address, *supra* note 105.
116 *Id.*
117 Edward Oldmeadow & Dora Marinova, *Into Geothermal Solutions: The Sustainability Case for Challenge Stadium in Perth, Western Australia*, 30 ENVTL. PROGRESS & SUSTAINABLE ENERGY 476, 476–77 (2011) (citations omitted).
118 *See* TESTER ET AL., *supra* note 1, at 505.

2. COMPULSORY LICENSING

Compulsory licensing can be effective for medical technologies because these technologies are often constrained to one drug for one illness. At least thirty-nine sub-Saharan African countries have compulsory licensing provisions in their patent laws, although the use of this provision has been rare.[119] However, compulsory licensing, as well as the research and experimental use exception (tools in TRIPS which are well-designed for medical technologies), may be technically and administratively difficult for sustainable energy technologies.[120] For example, the research and development to provide the technology to build a solar or biofuel power plant, or control emissions from an automotive factory may be well understood or available in the public domain. However, significant costs still remain to make these solutions viable, due to the actual costs of construction and developing ancillary infrastructure. Therefore, even if states used compulsory licensing to bring these technologies to their local industries, the problem of capital outlay remains before the technologies can be effectively implemented.

3. THE SYSTEMATIC REASONS FOR DOHA'S SUCCESSES IN FIGHTING HIV/AIDS MAY NOT BE HELPFUL FOR SUSTAINABLE ENERGY TECHNOLOGIES

TRIPS and Doha have had successes in fighting diseases, especially HIV/AIDS. Generic drug manufacturing has created competition in the antiretroviral market, playing a major role in the fall of antiretroviral prices in the past decades.[121] This competition has enabled individuals, governments, and international funding agencies—such as the Global Fund and the President's Emergency Plan for AIDS Relief—to afford these treatments.[122] "Generic competition has drastically reduced by almost 99% the annual price of first-line antiretroviral drugs. In 2000 such treatment cost more than US $10000 per person per year. By 2010, the least expensive WHO-recommended first-line antiretroviral regimen cost less the [sic] US $120 per person per

---

[119] UNAIDS, *supra* note 88, at 16–17.
[120] Jayashree Watal Webcast Address, *supra* note 105.
[121] UNAIDS, *supra* note 88, at 3.
[122] *Id.*

year."[123] This price reduction demonstrates how HIV management and treatment scale-up have profoundly changed perceptions and approaches to global health.[124] In concert with these price decreases, the estimated antiretroviral coverage for HIV in sub-Saharan African countries has increased from one percent in 2004 to thirty-seven percent in 2010.[125]

TRIPS flexibilities have played a role in creating this success. These flexibilities have helped to address issues with access to medicines and barriers to research and development.[126] The use of flexibilities has included compulsory licensing, parallel importing, remedial measures against pharmaceutical companies that engage in anti-competitive practices, limiting the scope of pharmaceutical patents, accelerating the introduction of generic medicines by allowing regulatory agencies to work together with industry, and broadening the ability of regulatory authorities to approve generic medicines.[127] Such successes also reflect the role that the Doha Declaration has played in encouraging least-developed states and other organizations to find harmony between protecting their public health interests and maintaining incentives for technology innovation.[128]

However, the drivers for such successes may not apply to sustainable energy technologies. Unlike medical products, for which price plans may be tiered to target consumers with different income levels, energy technologies will not be competitive unless they can be sold to end users at prices on par with or lower than the going market rate. For example, Thailand successfully used compulsory licensing for a number of pharmaceutical products, while recognizing its ability to charge multiple levels of prices for these products.[129] Thailand's health minister emphasized the importance of the balance between diffusion of essential drugs and promotion of innovation.[130] He also explained that

---

[123] *Id.*
[124] *Id.* at 13.
[125] *Id.* at 15.
[126] *Id.* at 13.
[127] *Id.*
[128] *Id. But see* Reed Beall & Randall Kuhn, *Trends in Compulsory Licensing of Pharmaceuticals Since the Doha Declaration: A Database Analysis*, PLOS MEDICINE, Jan. 2012, at 1, 7, *available at* http://www.plosmedicine.org/article/info%3Adoi%2F10.1371%2Fjournal.pmed.1001154 (arguing that Doha may not have been a significant driver for the successes in the fight against HIV; rather, the public campaign may have actually played this role).
[129] UNAIDS, *supra* note 88, at 20.
[130] *Id.*

> When a government such as ours declares a "compulsory licence" to allow for public noncommercial use of patented products by the government for the greater public good, we are doing so to increase access to these essential, often life saving, medications for the poor and marginalized members of our communities who were not consumers of these expensive, patented drugs. The more well-off members of our society continue to consult their own private physicians and continue to pay – out of their own pockets – the price of patented medications.[131]

However, in a competitive market, no energy supplier would be able to differentiate amongst customers and charge prices significantly greater to one set of customers than to another set.

Similarly, although compulsory licensing may address some issues that least-developed countries have because of a lack of manufacturing capacity, this flexibility will not be as helpful for sustainable energy technologies because the cost of energy "manufacturing" is the primary barrier to sustainable development.[132]

Further, medical technology development is better suited to overcoming the technology valley of death that lies between demand-side and supply-side innovation. "[T]he 'public good' of better medicines is automatically matched by the large-scale purchase of better drugs by national health authorities, private health practices, or direct private purchase; and patenting of discrete, chemically-unique drugs provides strong protection for the manufacturers; thus the 'market pull' forces reach deep into the innovation chain."[133]

On the other hand, these kinds of practices are not as well suited to sustainable energy technology transfer and diffusion. Sustainable energy technologies entail different technical, financial, and political risks.[134] "Thus for a big, long-term problem like climate change, emissions constraints need to combine with research and development

---

[131] *Id.* at 21.

[132] *Id.* at 15–21. *But see* Vanessa Bradford Kerry & Kelley Lee, *TRIPS, the Doha Declaration and Paragraph 6 Decision: What are the Remaining Steps for Protecting Access to Medicines*, GLOBALIZATION & HEALTH, May 2007, at 1, 1, *available at* http://www.globalizationandhealth.com/content/pdf/1744-8603-3-3.pdf (arguing that compulsory licensing cannot cure all the issues surrounding the lack of manufacturing capacity in least-developed countries).

[133] Grubb, *supra* note 15, at 120.

[134] *Id.*

and a range of targeted supports to promote technology investment through different stages of the innovation chain."[135] Further, if an ideal Kyoto-like system does not prevail and lead to solutions, there will be even greater stress on the need for international technology cooperation to deliver "on the ground" changes to develop technologies and help them through the middle stages of the innovation chain, and also to "develop incentives for the large-scale diffusion of myriad efficient end-use as well as low-carbon supply technologies."[136]

D. SHORTCOMINGS IN TRIPS AND THE DOHA DECLARATION SUGGEST THAT A NEW PARADIGM IS NECESSARY TO ENCOURAGE SUSTAINABLE ENERGY DEVELOPMENT AND TECHNOLOGY TRANSFER

Though TRIPS and Doha provide flexibilities to least-developed countries to protect their public health,[137] these agreements do not fully cure the issues surrounding the weak manufacturing bases in least-developed countries. A weak manufacturing base widens the technology gap because it drastically increases the costs of high-technology products that require economies of scale and horizontal integration.[138] Additionally, most least-developed countries have weak specialization in advanced commerce-support services, which are vital to ensuring the stability of a technology-driven economy.[139]

The technology gap reflects the weak manufacturing base. For example, gross research and development expenditures in least-developed countries in 2003 constituted 0.2 percent of gross domestic product, one-tenth of that which took place in developed countries.[140] Further, between 1991 and 2004, only twenty US patents were granted to applicants from least-developed countries, compared to 1.8 million to applicants from developed countries.[141] Even if TRIPS and Doha provide avenues for these patented technologies to flow to least-developed

---

[135] *Id.*
[136] *Id.* at 125.
[137] TRIPS, *supra* note 83, art. 8; Doha Declaration, *supra* note 100, ¶ 17.
[138] CARLOS CORREA, INTELLECTUAL PROPERTY IN LDCS: STRATEGIES FOR ENHANCING TECHNOLOGY TRANSFER AND DISSEMINATION 3 (2007), *available at* http://www.unctad.org/sections/ldc_dir/docs/ldcr2007_Correa_en.pdf.
[139] *Id.*
[140] *Id.*
[141] *Id.*

countries, the weak manufacturing base makes it unlikely that these technologies can be properly absorbed and applied.

As such, traditional systems of innovation may be inappropriate for least-developed countries.[142] Technical learning, change, and growth in least-developed countries often takes place through assimilation of mature technologies that are in the public domain and thus accessed through informal channels such as the acquisition of machinery and reverse engineering.[143] Further,

> [a] crucial policy challenge for [least-developed countries] is to build productive capacities through improving the mechanisms of technology transfer and strengthening technological learning capacities in production at firm level. This will require, *inter alia*, to increase the knowledge component of their productive processes and to enhance their human capital formation and knowledge base.[144]

This is why some formal modes of transfer are valuable and should be encouraged. In particular, turn-key agreements for the establishment of sustainable energy plants, especially where "production processes are complex and plant lay-outs are difficult to imitate," will be valuable for improving the energy manufacturing base for least-developed countries,[145] and could potentially lead to greenhouse gas emissions reductions.

More broadly, FDI needs to be encouraged as a tool for technology transfer. FDI is valuable because "local absorptive capacities are low and foreign investors need to be directly involved in the creation of local capacity for production."[146] The absorptive capacity problem is critical because innovation-related intellectual property rights may actually be illusory for most firms in least-developed countries because they suffer from concerns such as "[p]oor managerial capacity and skill level of workers, poor financing or lack of access to financial capital, poor support services, weak industrial and social infrastructure, poor marketing and distribution networks, and a poor technological knowledge base."[147]

---

142 *Id.*
143 *Id.* at 4 n.5.
144 *Id.* at 4.
145 *Id.* at 5.
146 *Id.*
147 *Id.* at 8.

Although the text of TRIPS has created a positive legal obligation for developed Members to transfer technologies to least-developed Members,[148] and also to provide technical and financial cooperation,[149] TRIPS has not successfully led to meaningful technology transfer in practice at the state level. An analysis of self-reported technology transfer actions from 1999–2007 shows that developed countries have failed to meet their end of the TRIPS bargain.[150] Developed states have poorly performed in targeting least-developed countries as the recipients of technology transfer, and many of the actions reported did not actually have to do with technology transfer under its formal definition.[151] These actions also have not referred to TRIPS Art. 66.2 as the driver for their technology transfer, suggesting that this legal tool may not be sufficient to drive sustainable energy technology transfer.[152] In addition, while the UNFCCC has similar language, requiring highly-developed state members to promote, facilitate, and finance technology transfer, it is unclear if this legal tool has had any effect either.[153]

CONCLUSION

Climate change remains a complex and difficult problem that will require solutions that combine several different perspectives and approaches. Intellectual property solutions should build upon TRIPS and the Doha Declaration to emphasize the connection between innovation and the protection of public health. Over time, the distinction between public health as related to only epidemic diseases and as related to climate change will blur, as the latter begins to exacerbate the former.

Investment in turn-key projects for sustainable energy plants[154] will be a key driver for providing one of the necessary wedges to reduce greenhouse gas emissions. Such investment will need to be coupled with an intellectual property regime that emphasizes both "supply-side

---

148 TRIPS, *supra* note 88, art. 66, ¶ 2.
149 *Id.* art. 67.
150 *See generally* CORREA, *supra* note 138, at 3.
151 Moon, *supra* note 95, at 8.
152 *Id.*
153 *Id.*
154 Such plants could run on technologies ranging from wind to solar to tidal power. For further analysis of the benefits and costs of sustainable energy technologies, see TESTER ET AL., *supra* note 1, at xxvii–xxiv.

pushing" and diffusion of innovative technologies, as well as "demand-side pulling" and absorption of these technologies so that least-developed countries can maintain the knowledge gains, overcome the technology gap, and help strengthen their energy manufacturing base. Financial incentives such as those provided by Kyoto's Clean Development Mechanism may need to be explicitly implemented in a TRIPS/Doha-like agreement, especially if Kyoto sunsets without any similar replacement, since the existing legal obligations for technology transfer in TRIPS do not seem to have been effective so far.

Because investment remains a major problem for implementing sustainable technologies, FDI could be a solution. However, FDI may only be a viable short-term option. Studies have shown that FDI does not necessarily help the development of a technological base in the host country, which is one of the primary goals of TRIPS.[155] Without this technological base, least-developed countries, being too dependent on foreign investment, may not be able to develop self-sufficient industries for producing sustainable technologies. Therefore, any long-term solution for introducing sustainable technologies in least-developed countries will require a novel regime to supplement TRIPS that provides greater incentives to foreign corporations to develop lasting infrastructure in the host states.

A long-term solution could provide such incentives by pairing corporations in highly-developed states with sustainable energy projects in developing states. The Kyoto Protocol's CDM could provide the foundation for a robust sustainable energy development and transfer program. For example, highly-developed states could receive carbon credits, or preferential financial treatment for renewable projects from organizations such as the World Bank and the International Monetary Fund. These projects could be tailored to any of the paradigms and wedges for fighting climate change introduced in Part II. Such flexibility could draw in a broader range of entities interested in developing sustainable energy projects from both highly-developed and developing states.

---

[155] *See* Evelyn Su, *The Winners and The Losers: The Agreement on Trade-Related Aspects of Intellectual Property Rights and Its Effects on Developing Countries*, 23 HOUS. J. INT'L L. 169, 209 (2000).