March 7, 2011

The Patent System and Climate Change

Joshua D Sarnoff, *DePaul University College of Law*

The Patent System and Climate Change

Abstract

The amount of greenhouse gas emissions and consequent climate changes and social responses will depend substantially upon the rapid development and widespread dissemination of a wide variety of new mitigation and adaptation technologies. The international approach adopted by the UN Framework Convention on Climate Change in Cancun will focus the worldwide innovation system more closely on private funding and markets, and thus on the acquisition of patents at the front end of the coming innovation pipeline. The choice to rely on private markets and patents is highly debatable. But it is certain to create substantial tensions for the patent system to assure low-cost access to patented technologies at the back end of technology transfer needs.

This article first describes the uncertain case for relying on the patent system, the tensions that will result from the unbalanced worldwide patenting of climate change technologies, the magnitude of the coming innovation needs, and the measures that have been proposed to limit the effect of the patent system on development of and access to climate change technologies. The article then describes six proposals for maximizing the innovation potential of the patent system while minimizing the costs of access in both the developed North and the developing South. The first set of proposals focuses on protecting research, directing patent incentives towards where they are most needed, and assuring inter-operability of innovations with patented technologies. The second set of proposals focuses on retaining and using ownership powers (and making better use of regulatory powers that look very similar) to better assure widespread access and low-cost licensing of patented technologies. The final proposal addresses expanding access to patented technologies that are voluntarily supplied at low cost to certain markets. These measures are more likely to be employed, to be more effective, and to be perceived as fairer and as less harmful to ex- ante innovation incentives than the alternative, ex-post regulatory actions that will remain available.

Table of Contents

INTRODUCTION 1

I. The Current Technology Innovation and Dissemination Context 8

A. Theoretical and Empirical Uncertainties Regarding Patents, Invention, Innovation, and Technology Diffusion 8

B. Unbalanced Worldwide Patterns of Innovation, Patenting, and Technology Transfer and Resulting Tensions 15

C. International Funding, Timing, and Transfer of Various Climate Change Technologies 21

D. Existing International Technology Transfer Measures and Proposals to Regulate Patents for Climate Change Invention and Technology Transfer 26

II. Critical National and Private Policy Levers to Mitigate the Adverse Effects of Patents for Climate Change Technologies 29

A. Broad Patent Eligibility Exclusions for Basic R&D to Direct Innovation to More Creative Applications 32

B. Robust Experiment Use and Inter-Operability Exceptions 39

C. Retained Research and Humanitarian Licensing Powers 44

D. Presumptions of Non-Exclusive Licensing 46

E. Expansive and Clearer March-In Criteria 48

F. Expansive Exhaustion (Parallel Importation) Criteria 51

CONCLUSION 54

INTRODUCTION

Over the next few decades, tens of trillions of dollars will be needed for the development and dissemination of a wide range of new technologies to upgrade infrastructure and to mitigate and to adapt to the effects of climate change (climate change technologies).[1] As the Executive Secretary of the United Nations Framework Convention on Climate Change (the UNFCCC) put it, human "'survival depends on our improvement of technology.'"[2] Climate change is expected to cause dramatic changes to weather patterns, to adversely affect health (particularly for vulnerable populations), ecosystems, food production, and water availability, to displace populations and disrupt land and resource ownership, and to interfere with existing patterns of satisfying basic human needs.[3] The amount of greenhouse gas emissions and the extent of climate change, as well as the problems that climate change will cause and how well society responds, will depend substantially upon the rapid development and widespread dissemination of a wide variety of new climate change technologies. The availability of substantial public funds and the huge potential private markets will attract new technological development and will encourage patenting (to differing degrees in various industries) in the hopes of appropriating returns.[4] In turn, the costs of climate change mitigation and adaptation measures will depend on whether these climate change technologies are patented, on how they are licensed, and on what technological substitutes are affordably available.[5]

---

[1] *See, e.g.,* Lawrence H. Goulder & William A. Pizer, Resources for the Future Discussion Paper: The Economics of Climate Change, RFF DP 06-06, at 13 (Resources for the Future June 2006) (discussing anticipated energy investments); THE WORLD BANK, WORLD DEVELOPMENT REPORT 2010, at 6-7 (Washington, DC advanced press ed. 2009) (hereinafter "WORLD BANK DEVELOPMENT REPORT") (discussing anticipated transportation investments).

[2] Catherine Saez, *Human Survival Depends on Shared Technology, Says New UN Climate Chief,* Intellectual Property Watch (Sept. 3, 2010), at http://www.ip-watch.org/weblog/2010/09/03/human-survival-depends-on-technology-says-new-un-climate-chief/?utm_source=post&utm_medium=email&utm_campaign=alerts.

[3] *See, e.g.,* Intergovernmental Panel on Climate Change, *Summary for Policymakers,* in CLIMATE CHANGE 2007: FOURTH ASSESSMENT REPORT, SYNTHESIS REPORT (AR4) 9-15 (Cambridge U. Press. 2007) (hereinafter "IPCC FOURTH ASSESSMENT REPORT").

[4] *See generally* Wesley M. Cohen et al., Protecting Their Intellectual Assets: Appropriability Conditions and Why U.S. Manufacturing Firms Patent (Or Not) 2 (Nat'l. Bureau of Econ. Research Working Paper No. w7552, 2000), available at http://www.nber.org/papers/w7552.

[5] *See* John H. Barton, Intellectual Property and Access to Clean Energy Technologies in Developing Countries: An Analysis of Solar Photovoltaic, Biofuel, and Wind Technologies, International Center for Trade and Sustainable Development Issue Paper No. 2 x-xii (Dec. 2007), available at http://ictsd.net/downloads/2008/11/intellectual-property-and-access-to-clean-energy-technologies-in-developing-countries_barton_ictsd-2007.pdf; John H. Barton, Mitigating Climate Change Through Technology Transfer: Addressing the needs of Developing Countries, Energy, Environment and Development Programme: Programme Paper 08/02, Chatham House 9-10 (Oct. 2008), available at http://www.chathamhouse.org.uk/files/12357_1008barton.pdf. *See also* Copenhagen Economics, Are IPR a Barrier to the Transfer of Climate Change Technologies 4 (Jan. 19. 2009), available at http://trade.ec.europa.eu/doclib/docs/2009/february/ tradoc_142371.pdf. It is important to note that Barton's assumptions of price constraints on patented climate change technologies assumes ready substitutes for existing technologies, or development of incremental, rather than breakthrough, technologies. *See, e.g.,* Maria J. Oliva et al., Climate Change, Technology Transfer and Intellectual Property Rights 67 (ICTSD, Aug. 2008), available at http://ictsd.org/i/publications/31159 (summary by John Barton of in-session discussion of concerns that such substitution may not occur); Keith E. Maskus & Ruth Okediji, Intellectual Property Rights and International Technology Transfer to Address Climate Change: Risks, Opportunities and Policy Options 10 (ICTSD Dec. 2010)

In Cancun, at the end of 2010, the UNFCCC adopted an agreement that places substantial emphasis on developing and disseminating technology through private markets, although it also contemplates transferring public and private funds from developed countries (in the context of their mitigation measures) to developing countries of at least US$ 100 billion per year by 2020.[6] Vast amounts of money, mobilized in part by the prospect of large commercial markets for climate friendly technologies and prompted in part by governmental development funding, will be spent in the energy, transport, agriculture, forestry, and other industrial and social sectors. In the United States under the Bayh-Dole Act[7] (and increasingly in other countries[8]), universities and small businesses receiving government research and development ("R&D") funds may take title to and patent most resulting inventions.[9] The anticipated worldwide funding for technology development and the ability of private institutions to take title to government-funded inventions will focus the worldwide innovation system even more closely on the acquisition of patents at the front end of the coming innovation pipeline, and thus on assuring low-cost access to patented technologies at the back end of the technology transfer needs.

The magnitude and social importance of these developments will place significant stress on the patent system and its use for scientific and technical innovation, technology development, and technology and product transfer and public dissemination. It will also focus attention on the patent system's theoretical justifications[10] and alternatives to the patent system such as public domain treatment,[11] public procurement,[12] and creation of constructed commons.[13] As with other serious global

---

(noting that some environmentally sound technology patents may provide substantial market power "in certain locations or market conditions" raising serious access barriers). *Cf.* Bronwyn Hall & Christian Helmers, The Role of Patent Protection in (Clean/Green) Technologies, National Bureau of Economic Research Working Paper 16323, at 7 (Sept. 2010), available at http://www.nber.org/papers/w16323 ("Most technological progress is expected to come from incremental improvements of existing, off-patent technologies.").

[6] *See* UNFCCC, Draft Decision CP.16, Outcome of the work of the Ad Hoc Working Group on long-term Cooperative Action under the Convention , ¶¶ IV.A.98-99 (2010) (hereinafter "UNFCCC Cancun Agreement"), available at http://unfccc.int/files/meetings/cop_16/application/pdf/cop16_lca.pdf.

[7] University and Small Business Patent Procedures Act of Dec. 12, 1980, Pub. L. No. 96-517, § 6(a), 94 Stat. 3015, 3019-27 (codified in relevant part at 35 U.S.C. §§ 200-211, 301-07) (hereinafter "Bayh-Dole Act").

[8] *See, e.g.,* Sangyu Katsuryoku Saisei Tokubetsu Sochiho (Japanese Bayh-Dole Act), Ch. 3, Arts. 30-33, Japanese Law No. 131 of 1999, English information available at http://www.meti.go.jp/english/information/data/cIP9972e.html; Intellectual Property Rights from Publicly Financed Research and Development Act, 2008, 522 Republic of South Africa Government Gazette No. 31745 (Dec. 22, 2008); The protection and utilization of public funded intellectual property bill, 2008, Indian Bill No. LXVI of 2008. *See generally* Thomas J. Siepmann, *The Global Exportation of the U.S. Bayh-Dole Act,* 30 U. OF DAYTON L. REV. 209 (2004).

[9] *See, e.g.,* 35 U.S.C. § 202(a) (non-profits and small businesses may elect to take title to funded inventions).

[10] *See, e.g.,* Fritz Machlup & Edith Penrose, *The Patent Controversy in the 19th Century,* 10 J. ECON. HIST. 1, 10-29 (1950) (discussing traditional arguments for patents based on natural rights in ideas, just rewards for inventors, incentives for invention, and incentives for disclosure of secrets).

[11] *See, e.g.,* JAMES BOYLE, THE PUBLIC DOMAIN: ENCLOSING THE COMMONS OF THE MIND (2008).

[12] *See, e.g.,* Denis Borges Barbosa & Charlene de Avila Plaza, *The role of government procurement in regard to development , dissemination, and costs of climate change technologies,* in RESEARCH HANDBOOK ON INTELLECTUAL PROPERTY AND CLIMATE CHANGE __ (Joshua D. Sarnoff ed. Edward Elgar Press forthcoming 2011) (herineafter "IP&CC RESEARCH HANDBOOK").

[13] *See, e.g.,* Uma Suthersanen & Graham Dutfield, *Innovation and the Law of Intellectual Property,*

problems, such as access to medicines[14] and the sharing the benefits of biodiversity and of the genomes of pathogenic organisms,[15] climate change raises important human rights concerns.[16] Thus, these issues are likely to bounce among international treaty regimes (through so-called regime shifting) as they arise at different times in different environmental, trade, and intellectual-property treaty fora.[17] At the domestic level, governments and private institutions and actors will be forced to decide whether and what patent rights to grant or seek for climate change-related inventions,[18] and how broadly to license them and what conditions to place on such licenses. Governments will also need to decide what kinds of creative discoveries should be treated as patent eligible inventions, what parameters to adopt for various patentability doctrines, what exceptions to create to patent rights, and whether and how to regulate competition and prices in markets for patented climate change technologies.

Most patented mitigation and adaptation technologies are being developed in a small group of developed countries and emerging economy countries (which will collectively be referred to as the "North," although emerging economies typically are not included in the designation).[19] Thus, the focus

---

in INNOVATION WITHOUT PATENTS: HARNESSING THE CREATIVE SPIRIT IN A DIVERSE WORLD (Uma Suthersanen et al. eds., 2007); Michael J. Madison, Brett M. Frischmann & Katherine J. Strandburg, Constructing Commons in the Cultural Environment, 95 CORNELL L. REV. 657 (2010).

[14] *See, e.g.,* World Trade Organization, Declaration on the TRIPS Agreement and Public Health, WT/MIN(01)/DEC/2 (Nov. 20, 2001), available at http://www.wto.org/english/thewto_e/minist_e/min01_e/mindecl_trips_e.htm (hereinafter "Doha Declaration")..

[15] *See, e.g.,* Convention on Biological Diversity, The Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity (Oct. 29, 2010, Nagoya Japan), available at http://www.cbd.int/abs/doc/protocol/nagoya-protocol-en.pdf; World Health Organization, Pandemic Influenza preparedness: sharing of influenza virus and access to vaccines and other benefits: Outcome of the resumed Intergovernmental Meeting, A62/5 Add. 1, Appendix (May 18, 2009) (negotiated framework for sharing of viruses and access to benefits), available at http://apps.who.int/gb/ebwha/pdf_files/A62/A62_5Add1-en.pdf.

[16] *See generally* HUMAN RIGHTS AND CLIMATE TECHNOLOGY POLICY, USING TECHNOLOGY TO PROTECT RIGHTS IN A CLIMATE-CONSTRAINED WORLD (Stephen Humphreys ed., International Council on Human Rights Policy forthcoming 2011).

[17] *See, e.g., supra* note __-__ and accompanying text; Lawrence R. Helfer, *Regime Shifting: The TRIPS Agreement and New Dynamics of International Intellectual Property Lawmaking,* 29 YALE J. INT'L L. 1, 42-25 (2004) (discussing regime shifting between the World Health Organization and World Trade Organization in regard to public health and access to medicines); Jorge Cabrera Medaglia, *The Relationship Between the Access and Benefit Sharing International Regimen and Other International Instruments: The World Trade Organization and the International Union for the Protection of New Varieties of Plants,* 10 SUSTAINABLE DEV. L. & POL'Y 24 (2010) (discussing competing negotiations in the Convention on Biological Diversity, the World Trade Organization, and the International Union for the Protection of New Varieties of Plants (UPOV) regarding access and benefit sharing).

[18] *See, e.g.,* Maskus & Okediji, *supra* note __, at 8 (noting that, unlike for medicines, in most cases patent protection is not an important ex-ante incentive for inventions, but are applied for ex-post to protect inventions).

[19] *See, e.g.,* Antoine Dechezleprêtre et al., Invention and Transfer of Climate Change Mitigation Technologies on a Global Scale: A Study Drawing on Patent Data 3-4 (CERNA, Mines Paris Tech, Agence Française de Dévelopment Nov. 2008), available at http://www.nccr-climate.unibe.ch/conferences/climate_policies/working_papers/Dechezlepretre.pdf; Bernice Lee, Ilian Iliev & Felix Preston, A Chatham House Report: Who Owns Our Low Carbon Future?: Intellectual Property and Energy Technologies viii (Royal Institute of International Affairs Sept. 2009), available at http://www.chathamhouse.org.uk/files/14699_r0909_lowcarbonfuture.pdf; Patents and clean energy: bridging the gap between evidence and policy: Final report 9, 30-36 (United Nations Environment Programme (UNEP), European Patent Office, (EPO), and International Centre for Trade and Sustainable Development (ICTSD)

on private markets and patents will generate substantial trade tensions and will result in significant wealth transfers that will run against the flow of "common but differentiated responsibilities and respective capabilities" that the UNFCCC adopted in 1992 as a basic predicate for addressing climate change.[20] The reliance principally by the North on the patent system and the varying benefits of the patent system for the wide range of technologies and markets in the developing world (which will collectively be referred to as the "South")[21] will pose additional political confrontations, just as occurred in the context of production of and access to essential medicines.

It is generally believed that the patent system has failed to develop medicines needed principally for developing country markets,[22] and that financial and technological aid to the South remains inadequate in light of continuing high prices of the essential medicines developed for Northern markets that are available.[23] Unlike in the access to medicines context, for climate change many more industries and more heterogeneous market structures will be involved in development and dissemination of the needed technologies, and many more patents may apply to such technologies.[24] Additional concerns (particularly regarding to potential anti-commons effects) will thus arise in the climate change context, as they have in other contexts involving products and processes that are subject to a multiplicity of patents and patent rights.[25]

Concerns over the patent system and climate change have already caused serious political tensions. At an earlier stage of international negotiations (originally in Bonn and carried through to

---

pubs. 2010) (hereinafter "UNEP/EPO/ICTSD Study"), available at http://www.epo.org/topics/issues/clean-energy/study.html.

[20] United Nations Conference on Environment and Development [UNCED], *United Nations Framework Convention on Climate Change,* Art. 3.1 (hereinafter "UNFCCC Convention"), U.N. Doc. A/AC.237/18 (Part II)/Add.1 (May 9, 1992). *See id.* Arts. 3.2, 4.1-4.10.

[21] *See, e.g.,* Richard H. Cavazos Cepeda & Douglas C. Lippoldt, *The Strengthening of IPR Protection: Policy Complements,* 2 W.I.P.O. J. 99, 101-02, 110-12 (2010).

[22] *See, e.g.,* Stephen Maurer, When Patents Fail: Finding New Drugs for the Developing World 3 (May 27, 2005) (discussing the failure of patents to induce development and licensing of "diseases of poverty"), available at http://gspp.berkeley.edu/iths/Maurer_WhenPatentsFail.pdf.

[23] *See, e.g.,* World Health Organization, UN Millenium Development Goals Task Force report 2010, Executive Summary: Access to Affordable Medicines, at xi, available at http://www.who.int/medicines/mdg/ MDG8ExecSummary.pdf.

[24] *Cf., e.g.,* Mark A. Lemley & Julie E. Cohen, *Patent Scope and Innovation in the Software Industry,* 89 CALIF. L. REV. 1, 5-6 (2001) (discussing particular features of software products that may suggest differences of patent standards, specifically "rapid sequential innovation, reuse and recombination of components, and strong network effects that privilege interoperable components and products"); Dan L. Burk & Mark A. Lemley, *Is Patent Law Technology Specific?,* 17 BERKELEY TECH. L.J. 1155, 1158-85(2002) (discussing differentiation of patent standards by technology, specifically for software and biotechnology).

[25] *See, e.g.,* Michael A. Heller & Rebecca S. Eisenberg, *Can Patents Deter Innovation? The Anticommons in Biomedical Research,* 280 SCIENCE 698, 698-99 (1998); James Bessen and Robert M. Hunt, *An Empirical Look at Software Patents,* National Bureau of Economic Research Working Paper No. 03-17/R , at 4-5 (Mar. 2004), available at http://www.researchoninnovation.org/swpat.pdf; Paul A. David, *Mitigating "Anticommons" Harms to Research in Science and Technology: New Moves in "Legal Jujitsu" against Unintended Adverse Consequences of the Exploitation of Intellectual Property Rights on Results of Publicly and Privately Funded Research,* 2 W.I.P.O. J. 59, 62-63 (2010) (summarizing studies of royalty stacking and other anticommons effects in various industries and scientific research). *See generally* MICHAEL HELLER, GRIDLOCK ECONOMY (Basic Books 2008).

Copenhagen), the UNFCCC Ad Hoc Working Group on Longterm Cooperative Action (WG-LCA) considered various proposals that had been suggested by the developing South (and emerging economies). These measures would have placed significant restrictions on the traditional operation of the patent system, ranging from required patent pooling and royalty-free compulsory licensing to excluding green technologies entirely from patenting and even retroactively revoking existing patent rights.[26] Efforts to impose these and other measures are likely to recur at the national level, within the existing regime of international intellectual property treaties, particularly the TRIPS Agreement.[27] Such national efforts, moreover, will likely expand as the mitigation and adaptation needs become more pressing and as the needed technologies are developed, in light of widely (if not uniformly) shared perceptions that stronger intellectual property rights are not in the interests of the developing South.[28]

This article addresses some of the tensions at the intersection of the patent system and climate change. Substantial theoretical and empirical uncertainties remain regarding whether the patent system is the best method of promoting innovation and dissemination of technologies.[29] Given the world's debatable choice in Cancun to rely substantially on the patent system and private markets to do so for the needed climate change technologies,[30] the article describes various doctrinal measures that are available to both the developed North and the developing South and are consistent with existing international treaties. These proposals should provide the greatest potential for maximizing innovation within the patent system and for improving access to the patented technologies that will result.

---

[26] *See, e.g.,* UNFCCC, Ad Hoc Working Group on Long-Term Cooperative Action Under the Convention, Ideas and proposals on the elements contained in paragraph 1 of the Bali Action Plan 23 (March 13, 2009) (proposal by China for compulsory licensing of patents, measures to restrict monopoly powers, intellectual property sharing arrangements, and retention of publicly funded inventions in the public domain), available at http://unfccc.int/resource/docs/2009/awglca5/eng/misc01.pdf; UNFCCC, Ad Hoc Working Group on Long-Term Cooperative Action Under the Convention, Report of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention on its seventh session, held in Bangkok from 28 September to 9 October 2009, and Barcelona from 2 to 6 November 2009, FCCC/AWGLCA/2009/14, at 156 (Nov. 20, 2009) (proposing to "mandatorily exclude from patenting climate-friendly technologies held by Annex II countries"), available at http://unfccc.int/resource/docs/2009/awglca7/eng/14.pdf; Hall & Helmers, *supra* note __, at 5. *See also* Estelle Derclaye, *Should Patent Law Help Cool the Planet? An Inquiry from the Point of View of Environmental Law: Part 1,* 31 EUR. INTELL. PROP. REV. 168, 183–84 (2009) (environmentally harmful inventions should not be patent eligible); Estelle Derclaye, *Should Patent Law Help Cool the Planet? An Inquiry from the Point of View of Environmental Law: Part 2,* 31 EUR. INTELL. PROP. REV. 227, 227, 230 (2009) (same).

[27] World Trade Organization, Agreement on Trade-Related Aspects of Intellectual Property Rights (hereinafter "TRIPS Agreement"), Apr. 15, 1994, 33 I.L.M. 81.

[28] *See, e.g.,* Lee Branstetter et al., *Has the Shift to Stronger Intellectual Property Rights Promoted Technology Transfer, FDI, and Industrial Development,* 2 W.I.P.O. J. 93, 95 (2010).

[29] *See, e.g.,* Fritz Machlup, *An Economic Review of the Patent System,* U.S. Senate Study No. 15, at 56, 62, 80 (1958); Rudolph J.R. Peritz, Patents and Progress: The Economics of Patent Monopoly and Free Access 10 (July 21, 2008), available at http://www.nyls.edu/centers/harlan_scholar_centers/institute_for_information_law_and_policy/publications. *Cf.* F.M. Scherer, *A Half Century of Research on Patent Economics,* 2 W.I.P.O. J. 20, 23-27 (2010) (emphasizing that first-mover advantages are more important than patent protection for technology development).

[30] *See, e.g.,* Keith E. Maskus, *Intellectual Property and the Transfer of Green Technologies: An Essay on Economic Perspectives,* 2009 W.I.P.O. J. 133, 136 (noting the lack of analysis and evidence regarding comparative benefits of carbon taxes or emissions trading to impose prices on emissions, direct government funding of R&D, and patent rights in inducing either R&D or innovation in climate change technologies).

The first set of proposals focuses on limiting what can be patented so as to direct funds and creative efforts where they are most needed, while protecting experimentation, sequential innovation, and inter-operability of innovations with the patented technologies that are developed. The second set of proposals focuses on retaining public and private ownership powers (and making better use of regulatory powers that look very similar) to better assure widespread access and low-cost licensing of patented technologies. The final proposal focuses on expanding access to patented technologies that are voluntarily supplied at low cost to certain markets. These measures not only are likely to prove more feasible to adopt, but also should avoid the need to resort to more controversial measures such as categorical technological exclusions from the patent system or ex-post regulatory actions such as compulsory licensing, antitrust scrutiny, or price controls,[31] which are correspondingly less likely to occur.[32] Nevertheless, such broad powers to compel licensing and to lower prices will remain available to countries and are legal under existing international intellectual property law treaties, and thus may act as backup measures to induce voluntary licensing or negotiated price reductions.[33]

The proposed measures are: (1) adopting stringent interpretations on what qualifies as a patent eligible invention, by supplementing the common exclusion from the patent system for scientific principles, physical phenomena, and abstract ideas with a requirement for significant additional creativity (as is already the law in the United States); (2) adopting robust experimental use and reverse engineering and inter-operability exceptions so as to protect sequential research and innovation and to assure the usability of innovations that must interact with patented technologies; (3) retaining non-commercial research and education and "humanitarian" licensing powers for both government funded and privately owned patented technologies; (4) using ownership powers to revise presumptions of exclusive licensing in regard to patented inventions; (5) expanding and clarifying the grounds for exercising public "march-in" rights in regard to government funded inventions; and (6) adopting permissive exhaustion standards (preferably at the regional rather than the full international level) to permit parallel importation when patent holders are willing to voluntarily supply particular markets at low cost with their patented technologies. These measures will better protect sequential innovation

---

[31] *See, e.g.,* K. Ravi Srinivas, Climate Change, Technology Transfer and Intellectual Property Rights, Research and Information System for Developing Countries Discussion Paper #153, at 26-27 (Apr. 2009) (discussing compulsory licensing and refusals to deal in patented technologies, particularly to meet environmental standards), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1440742; Jerome H. Reichman, *Intellectual Property in International Perspective: Institute for Intellectual Property & Information Law Symposium,* 48 HOUS. L. REV. 1115, 1137-38 (2009) (discussing compulsory licensing); Peter Lee, *Toward a Distributive Commons in Patent Law,* 2009 WIS. L. REV. 917, 974-76 (discussing the National Institute of Health's early efforts to impose price controls through contractual funding arrangements and abandonment of the policy in light of lobbying efforts and fears of lost innovation partnerships). *Cf. id.* at 998 (arguing that any harms caused by contractual restrictions imposing distributive obligations on patents to ex ante incentives to commercialize patented technologies have been minimal); CNBC, China Plans Price Controls to Tackle Food Inflation (Nov. 16, 2010), available at http://www.cnbc.com/id/40204726/China_Plans_Price_Controls_to_ Tackle_Food_Inflation. *See generally* TU THANH NGUYEN, COMPETITION LAW, TECHNOLOGY TRANSFER AND THE TRIPS AGREEMENT: IMPLICATIONS FOR DEVELOPING COUNTRIES (Edward Elgar Press 2010).

[32] *See, e.g.,* Reichman, *supra* note __, at 1139.

[33] *See, e.g.,* Robert Fair, *Does Climate Change Justify Compulsory Licensing of Green Technology,* 6 B.Y.U. INT'L L. & MGMT. REV. 21, 27-29 (2009); Jerome H. Reichman, *Comment: Compulsory Licensing of Patented Pharmaceutical Inventions: Evaluating the Options,* 37 J.L. MED. & ETHICS 247, 254 (2009) (also discussing direct price controls).

and access, particularly where technology transfer is needed to the developing South. By imposing these restrictions up front, the imposed limits on patents and the exercise of retained powers will reduce fairness concerns when government funders and private owners act for public benefit at private expense. In contrast, concerns over fairness and ex-ante innovation incentives are likely to be much more salient for ex-post regulatory measures such as compulsory licensing,[34] or any other measures that may be selectively and retrospectively applied by regulatory action.[35]

The paper proceeds as follows. Part I provides a summary of the current context of climate change mitigation and adaptation technologies and funding, and of the differential patterns of innovation, patenting, ownership, needs, and approaches to relying on the patent system. Part I.A. describes the recent Cancun Agreement and its focus on market-based, patent-system approaches, as well as describes one prominent non-market-based alternative (the Hartwell Paper[36]). It also discusses the continuing theoretical and empirical uncertainties that plague resolution of the best policies for promoting invention, innovation, and diffusion of technologies. Part I.B. discusses the highly unbalanced patterns of worldwide innovation, patenting, and technology transfer in regard to climate change technologies, and the corresponding trade tensions and wealth transfers that will result. Part I.C. discusses the magnitude of the funds that will likely flow in regard to developing climate change technologies, and the magnitude of patent rights that will consequently be owned, worked, and licensed. Part I.D. discusses various proposals that have to date been suggested to internationally regulate patent law doctrines for, or to modify patent rights in, climate change technologies.

Part II describes, in relevant subparts, the various measures listed above that could be adopted to minimize the risks of relying so heavily on the patent system. Although proposals to adopt any of these measures will no doubt be controversial, they are "policy levers"[37] that already are in play across the worldwide patent system. By focusing in Part II on preserving basic and sequential research and development and inter-operability free from patent rights, on retaining ownership rights to assure widespread and low cost dissemination of needed technologies, and on expanding access to voluntarily supplied, low-cost technologies, these specific policy levers may mitigate some of the greatest concerns over relying on the patent system while preserving its hoped-for benefits. And as all of the measures should be available and permissible under existing international intellectual property treaty law,

---

[34] *See, e.g.,* Intellectual Property Group Board Voices Opposition to Compulsory Licensing for Climate Action, BNA World Climate Change Report (Dec. 10, 2009) (noting resolutions of the board of the Intellectual Property Owners Association opposing compulsory licensing and other weakening of intellectual property rights during the Copenhagen conference), available at http://climate.bna.com/climate/document_newsarchive.aspx?ID=128784; Fair, *supra* note __, at 33-39.

[35] *See, e.g.,* Estelle Derclaye, *Not Only Innovation but also Collaboration, Funding, Goodwill and Commitment: Which Role for Patent Laws in Post-Copenhagen Climate Change Action,* 9 J. MARSHALL REV. INTELL. PROP. L. 657, 663 (2010). *Cf.* Alan Devlin, *The Misunderstood Function of Disclosure in Patent Law,* 23 HARV. J.L. & TECH. 401, 406, (2010) (noting the tension between ex-ante innovation incentives and expansive disclosure in regard to experimental use, patent eligible subject matter, remedies for infringement, and secrecy of pending applications).

[36] Institute for Science, Innovation and Society, University of Oxford & London School of Economics Mackinder Programme for the Study of Long Wave Events, The Hartwell Paper: A new direction for climate policy after the crash of 2009 24 (May 2010) (hereinafter "Hartwell Paper"), available at http://eprints.lse.ac.uk/27939/.

[37] Mark A. Lemley & Dan Burk, *Policy Levers in Patent Law,* 89 VA. L. REV. 1575 (2003).

different countries may and likely will choose different strategies for maximizing the innovation and diffusion of climate change technologies and for minimizing their costs.

I. The Current Technology Innovation and Dissemination Context

A. Theoretical and Empirical Uncertainties Regarding Patents, Invention, Innovation, and Technology Diffusion

In Cancun at the end of 2010, the Sixteenth Conference of the Parties of the UNFCCC reached agreement on an ambitious (many would say unrealistic) goal of limiting climate emissions so as to restrict temperature increases to no more than two percent (2%) above pre-industrial levels.[38] The premise for achieving this ambitious target is "a paradigm shift towards building a low-carbon society that offers substantial opportunities and ensures continued high growth and sustainable development, *based on innovative technologies* and more sustainable production and consumption and lifestyles, while ensuring a just transition of the workforce that creates decent work and quality jobs."[39] Existing and (particularly) new innovative climate change mitigation and adaptation technologies will vary substantially in character, ranging from efficiency methods employed by businesses and individuals (including codified and tacit knowledge and software) to products and industrial processes for making them.[40]

The range of technologies having climate effects, or accomplishing mitigation or adaption needs, is staggering. For example, the one U.S. study identified hundreds of technologies in various categories, such as "end-use/infrastructure (e.g. transportation), energy supply (e.g. hydrogen), carbon capture-storage (e.g. geologic storage), non-CO2 GHGs (e.g. methane from landfills), [and] measuring & monitoring capabilities (e.g. oceanic CO2 sequestration)."[41] A European study identified fifty one categories of technology, organized by industry sector or by conservation or pollution reduction goals.[42] Many studies have noted that the need for patents and how they operate may differ dramatically in regard to different kinds of technologies, industry sectors, and users and innovators.[43]

To develop and disseminate the needed technologies, the Cancun Agreement contemplates substantial private funding (and wealth transfers to the developing South) of technology development

---

[38] *See* UNFCCC Cancun Agreement, *supra* note __, ¶ I.4 (2010).
[39] *Id.* ¶ I.10 (emphasis added).
[40] *See, e.g.,* Thomas Brewer, Technology Transfer and Climate Change: International Flows, Barriers and Frameworks, Brookings Global Economy and Development 3-5 (Draft 1, 2008).
[41] *Id.* at 4 (citing the U.S. Climate Change Technology Program).
[42] *See id.* (citing the European Commission Environmental Technologies Action Plan).
[43] *See, e.g.,* Cohen et al., *supra* note __ (empirical analysis of differences between products and processes and across industries); Richard C. Levin et al., *Appropriating the Returns from Industrial Research and Development*, 18 BROOKINGS PAPERS ON ECON. ACTIVITY (SPECIAL ISSUE) 783 (1987) (same); Alan Devlin, Systematic Bias in the Patent System at 3-15 (unpublished draft 2011); Katherine J. Strandburg, *Users as Innovators: Implications for Patent Doctrine*, 79 U. COLO. L. REV. 467, 478 (2008). *See generally* Michael W. Carroll, *The Problem of Uniformity Cost in Intellectual Property Law,* 55 AM. U. L. REV. 848 (2008).

and deployment, and the consequent creation of intellectual property rights in new technologies.[44] Although governments can play an important role in stimulating innovation and technology diffusion through mechanisms such as public provision of necessary infrastructure, subsidized research, and prioritized public procurement, there are limits to government resources (particularly at local levels), and the public sector "does not always have the resources required to push through new projects independent of the IP-related costs involved."[45] Given the political difficulties of committing to massive expenditures as public obligations, the choice to rely on private markets hardly comes as a surprise.

Only Bolivia objected to the Cancun Agreement, focusing on the failure to address and regulate intellectual property rights.[46] As noted above, the WG-LCA had earlier considered numerous proposals to regulate intellectual property (particularly patents) in climate change mitigation and adaptation technologies,[47] which led in part to the inability to adopt significant emission reduction limits at the Fifteenth Conference of the Parties to the UNFCCC in Copenhagen.[48] By rejecting new regulation of intellectual property rights in the Cancun Agreement, the parties implicitly agreed that such issues would continue to be regulated under the existing intellectual property treaty regime, as was advocated by business groups (representing, *e.g.,* ExxonMobil, General Electric, Microsoft, and Phillips).[49]

In contrast, following the failure of the UNFCCC in Copenhagen to obtain consensus on binding carbon reduction commitments, various scholars offered a different international approach to addressing climate change. Specifically, the Hartwell paper proposed a more indirect approach to mitigating climate change by harnessing coextensive social motivations to adopt carbon free energy technologies, which will require "very substantially increased investment in innovation in non-carbon

---

[44] *See id.* ¶ IV.A. 95 (short term, governmental funding of US$ 30 billion for adaptation and mitigation, to be transferred from developing countries to developing countries); *id.,* ¶¶ 98-99 (long term funding "from a wide variety of sources, public and private," of US$100 billion per year, beginning by 2020).

[45] Chatham House Workshop Report, IPRs and the Innovation and Diffusion of Climate Technologies 3 (Nov. 16, 2007), available at http://www.chathamhouse.org.uk/publications/papers/view/-/id/722. *See, e.g.,* European Commission, Innovation – key issues for the European Council, Memo/11/59 (Feb. 1, 2011) (discussing various governmental roles), available at http://www.eulib.com/innovation-issues-european-council-13119; Ashley J. Stevens et al., *The Role of Public-Sector Research in the Discovery of Drugs and Vaccines,* 364 N.E. J. MED. 535, 535-37 (2011) (noting the importance of public sector research to public health).

[46] *See, e.g.,* Simon Crompton, *Bolivia rejects Cancun deal on IP grounds,* MANAGING INTELLECTUAL PROPERTY (Dec. 15, 2010) (noting that "in the end [Bolivia] only explicitly objected to the deal because not enough had been done to encourage the spread of clean technology by reducing IP rights"), available at http://www.managingip.com/Article/2737358/Bolivia-rejects-Cancun-deal-on-IP-grounds.html?Print=true.

[47] *See supra* note __ [Hall/Helmers and WGLGA].

[48] *See* UNFCCC, Decision CP.15, Copenhagen Accord (2009) (hereinafter "UNFCCC Copenhagen Accord"), available at http://unfccc.int/resource/docs/2009/cop15/eng/11a01.pdf#page=4.

[49] *See* Alliance for Clean Technology Innovation (ACTI), Clean Technology, Innovation and Development: A Road Map for Cancún, at 5 (Nov. 24, 2010) (on file with the author) (arguing that mechanisms for climate regulation "must not become fora for renegotiation of IP or other international and market commitments"); *id.* at 9 (arguing that IP "is already appropriately regulated at the international level, and no further IP-related provisions are needed," and that jurisdictional and interpretive problems of doing so "would jeopardize technology development and transfer, and reduce, rather than enhance, the transparency, predictability and effectiveness of the IP system").

energy sources to diversify energy supply technologies."[50] Unlike the predominantly market-driven approach to technology of the Cancun Agreement, the Hartwell Paper recognized that "radical acceleration of decarbonization of economic activity … will not be quickly or easily deployed [and thus] the primary RDD&D [research, development, demonstration and deployment] will have to be funded from the public purse."[51] The belief in the need for public funding was premised on a conclusion that "it is wrong to assume that a price on carbon[52] can induce the generality of firms to undertake the requisite R&D," given incentives for "leakage" to lower cost or unrestricted carbon-emission markets and "offset games," and because "basic research, development, and demonstration cannot be easily patented…. [and thus] the market has no incentive to fund it."[53]

It remains to be seen whether the Hartwell Paper scholars are correct that insufficient private technology investment funds will flow relative to climate change technology development and dissemination needs. Existing government funding for climate change technology development and diffusion, although increasing,[54] is certainly unlikely to be sufficient for the task. But the Hartwell Paper scholars' concern about the limits to patents on basic research (if not on development and demonstration of patented technologies) are particularly salient in light of recent judicial decisions regarding the patent eligibility of business methods, software, and biotechnology, which reiterate traditional exclusions for "laws of nature, physical phenomena, and abstract ideas"[55] (or "science, nature, and ideas") and for "products of nature,"[56] as well as decisions that limit the scope of exclusive rights in patentable biotechnology inventions to the uses disclosed in the patent specifications.[57]

Further, as recognized over 50 years ago by Fritz Machlup in his seminal report to the U.S. Congress, the patent system is only one of many, potentially overlapping alternative approaches to

---

[50] The Hartwell Paper, *supra* note __, at 5.

[51] *Id.* at 24.

[52] *Cf., e.g.,* Daniel J. Weiss & Kate Gordon, *Setting Limits,* 27 THE ENVIRONMENTAL FORUM 32-35 (Nov./Dec. 2010) (arguing that carbon taxes are needed to fund technology development in the clean energy sector).

[53] Hartwell Paper, *supra* note __, at 33. *See infra* text accompanying note __ [discussing leakage].

[54] *See, e.g.,* Grant Opportunities for Carbon Capture Technologies, http://www07.grants.gov/search/search.do?oppId=47854&flag2006=false&mode=VIEW (2009) (U.S. Department of Energy funding for one technology class); European Union, *Action Against Climate Change: Research and Development to Fight Climate Change*, http://ec.europa.eu/environment/climat/pdf/brochures/research_en.pdf (2009) (summary); European Union, ETAP [Environmental Technologies Action Plan]: Official Documents, http://ec.europa.eu/environment/etap/information/documents_en.html (discussing R&D funding for a range of technologies, including photovoltaics and hydrogen storage).

[55] Bilski v. Kappos, 130 S.Ct. 3218, 3225 (2010). *See generally* Joshua D. Sarnoff, *Patent Eligible Inventions after* Bilski: *History and Theory* (Feb. 7, 2011), available at http://ssrn.com/abstract=1757272.

[56] Association for Molecular Pathology v. U.S. Patent and Trademark Office, 702 F. Supp. 2d 181, 219 n.40 (S.D.N.Y. 2010) (citing Diamond v. Chakrabarty, 447 U.S. 303, 313 (1980)), *appeal docketed,* No. 2010-1406 (Fed. Cir. June 22, 2010).

[57] *See* Case C-428/08, Monsanto Technology LLC v. Cefetra BV and others, Judgment of the European Court of Justice ¶¶ 33-50 (July 6, 2020), available at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:62008J0428:EN:HTML (interpreting Council Directive 98/44/EC, art. 9, 1998 O.J. (L 213) (EC)).

innovation and the comparative advantage of patents to the alternatives was unproven and uncertain.[58] When insufficient market incentives exist for private development of technology in competitive markets,

> society has several choices: to make research grants or subsidies to selected industries or special private organizations; to promise prizes or bonuses for useful inventions made by private individuals or groups; to promise monopoly grants through patents; or to maintain governmental research agencies. It seems that the largest countries have adopted more than one of these possibilities.[59]

As a recent review of Machlup's work and of subsequent economic analyses of the patent system concluded, "the economics literature is inconclusive on whether patent protection is more effective than competition in promoting technological improvement and economic growth."[60] And as Machlup also noted, even once one has chosen to rely on a patent system, it is not self-evident that less generous patent policies will lead to reduced invention and innovation.

> One cannot simply and safely deduce that a reduction of expected returns from investment in innovations will diminish the flow of invention. According to one opinion on the system of general compulsory licensing –
>
> > ***no convincing argument has yet been put forward to show that *** a "license of right" system whereby, after a very short period, anyone might use a patent on paying a license fee to the inventor, would *** diminish the flow of invention.[61]

Conversely, given existing incentives to innovate, extending the patent system (and the kinds of inventions or discoveries that can be patent eligible) to areas of innovation that do not suffer from

[58] *See e.g.,* Machlup, *supra* note __, at 80 (concluding that uncertainties prevent policy recommendations except to "muddle through" by continued reliance on past policy);*id.* at 56 (noting tensions between justifications of patents as incentives for pre-patent invention and as incentives for post-patent innovation); *id.* at 62 (discussing the necessarily speculative nature of patent effects, given the inability to isolate patent effects); Rudolph J.R. Peritz, The Law and Economics of Progress: IP Rights and Competition Policy, 2010 Guido Carli Lecture 6 (Apr. 14, 2010) (discussing inconclusive studies conducted since Machlup and since Kenneth Arrow's similarly inconclusive theoretical analysis) (citing Kenneth J. Arrow, *Economic Welfare and the Allocation of Resources for Invention,* in THE RATE AND DIRECTION OF ECONOMIC ACTIVITY: ECONOMIC AND SOCIAL FACTORS 617 (R. Nelson ed. Princeton U. Press 1962)), available at http://www.luiss.it/it/risultati_ricerca.htm?cx=001096623058387578145%3Av5aiydfg6ku&cof=FORID%3A10&ie=UTF8&q=peritz+carli&siteurl=www.luiss.it%2Fprofessor_rjr_peritz2010_guido_carli_lecturethe_law_and_%2520economics_of_ progress.pdf#899.

[59] Machlup, *supra* note __, at 17.

[60] Peritz, *supra* note __, at 10.

[61] Machlup, *supra* note __, at 14 (quoting LIONEL ROBBINS, THE ECONOMIC BASIS OF CLASS CONFLICT 73 (London 1939)). *Cf. id.*at 74 (arguing that compulsory licensing "may be a serious deterrent" to investment in innovation, but remaining agnostic about the reasons to channel investments in innovations not yet proven effective, for which funding may be needed). *See generally* F. M. SCHERER, THE ECONOMIC EFFECTS OF COMPULSORY PATENT LICENSING, NEW YORK UNIVERSITY MONOGRAPH SERIES IN FINANCE AND ECONOMICS (1977).

public goods supply problems or from other market failures may impose utilitarian efficiency and deontological moral harms.[62]

Numerous studies have been made of the patent system to determine why firms choose to patent (or not), and whether patent rights are perceived as an incentive for investment, invention, and disclosure of technologies that would be developed (but otherwise might kept as trade secrets, which then pose difficulties for signaling opportunities for licensing and other transfers of the technologies).[63] The most recent study (the "Berkeley Study") focused on entrepreneurs, *i.e.,* early stage venture and non-venture financed startup companies. The study found relatively high rates of patenting for numerous reasons, with significant differences between industrial sectors and financing types.[64] The focus on entrepreneurs may be particularly relevant to climate change technologies, where significant technology-development opportunities may be recognized by non-incumbents, small-businesses, and individuals seeking either to capture a share of the emerging market or seeking to develop technology for social benefit.

Among the reasons for patenting identified by the Berkeley Study were: the traditional patent thesis of diminishing competition and securing profits for innovations (particularly for biotech and medical device companies); securing investments for growth; increasing liquidity (such as through acquisition or an initial public offering); serving a strategic role in negotiation; and defending against patent infringement suits.[65] The last reason cited by entrepreneurs is troubling. In 2003, the Federal Trade Commission had noted that defensive patenting could act as a tax on innovation – if companies acquire patents only to be free from litigation threats of competitors – rather than as a stimulus to innovation.[66] This is a particular concern for computer hardware and software inventions requiring multiple, potentially patented inputs. The FTC also noted that multiple patents could interfere with licensing through royalty-stacking, holdout behaviors, and barriers to entry.[67]

The Berkeley Study also found significant differences between venture capital-backed startups and other firms. The median venture-backed firm holds six or more patents or applications, and the

---

[62] *See, e.g.,* David S. Olson, *Taking the Utilitarian Basis for Patent Law Seriously: The Case for Restricting Patentable Subject Matter,* 82 TEMPLE L. REV. 181, 184, 192-204 (2009). *Cf.* Sarnoff, *supra* note __, at 12-13, 85-89 (discussing both utilitarian and deontological moral concerns with extensions of patent eligible subject matter).

[63] *See, e.g.,* Cohen et al., *supra* note __; Levin et al., *supra* note __. *Cf.* Katherine J. Strandburg, *What Does the Public Get? Experimental Use and the Patent Bargain,* 2004 WISC. L. REV. 81, 107-118 (discussing patent and trade-secrecy tradeoffs in regard to "self-disclosing" and "non-self-disclosing" inventions); Devlin, *supra,* at 405 & n. 18 417-19 (same, referring to "self-revealing" inventions) (citing Frank H. Easterbrook, *Intellectual Property is Still Property,* 13 HARV. J.L. & PUB. POL'Y 108, 109-10 (1990), and Kevin Iles, *A Comparative Analysis of the Impact of Experimental Use Exceptions in Patent Law on Incentives to Innovate,* 4 NW. J. TECH. & INTELL. PROP. 61, 64-65 (2005)).

[64] *See* Stuart J.H. Graham et al., *High Technology Entrepreneurs and the Patent System: Results of the 2008 Berkeley Patent Survey,* 24 BERKELEY TECH. L.J. 1255, 1255 (2009) (hereinafter "Berkeley Study").

[65] *See* Graham et al., *supra* note __, at 1287.

[66] *See* Fed. Trade Comm'n, To Promote Innovation: The Proper Balance of Competition and Patent Law and Policy 6-7 (2003) (hereinafter "FTC Innovation Report 2003"), available at http://www.ftc.gov/os/2003/10/innovationrpt.pdf.

[67] *See id.*

median other firm holds none.[68] Whether these differences make sense is uncertain, as they could reflect either particular needs or irrational desires of venture capitalists or firms relying on them. Further, "the likelihood of holding (or not holding) patents by technology startups does not appear to be driven by age effects, but instead by the company's business model, strategy, technology, or other factors, such as the cost of patenting and subsequent enforcement."[69] Unsurprisingly, the study found "profound disparities in the likelihood, number, and original source of patents by the technology focus and industry of the company."[70]

Significantly, the Berkeley Study reached similar conclusions to earlier studies that patents generally are not strong drivers of innovation, finding that "the technology startup executives responding to [the] survey report that patents offer relatively mixed to weak incentives to engage in innovation."[71] More specifically, the Berkeley Study found that:

> [a]mong the D&B [Dunn & Bradstreet-sampled] companies, respondents told us that on average, patents offer just above a "slight incentive" to engage in invention, R&D, and commercialization, and between "slight" and "no incentive at all" to create internal tools and processes. While venture-backed startup executives rate the incentive value more highly than do those at D&B companies, in no category are patents reported to provide even a "moderate" incentive for any of the four entrepreneurial activities about which we queried.[72]

The Berkeley Study thus raises serious concerns that for many technological fields, the patent system may not be functioning well, and may be similarly unlikely to do so for climate change technologies. It may either diminish innovation by operating as a tax or may be in sufficient to attract or properly direct the needed funding. The patent system certainly is not functioning uniformly among the entrepreneurs that the incentive for invention theory seeks to attract. In contrast, the patent system may be functioning better, if also non-uniformly, to facilitate venture capital funding of entrepreneurs who develop new technologies. Much may depend on the nature of the technology being patented and the timing of when commercialization is needed, as other studies have suggested that the scope of patent rights and how long they have existed, as well as the pioneering nature of the technology, may substantially affect its subsequent commercialization.[73]

Similarly, the other traditional rationale for the patent system of inducing disclosure rather than investment and invention also appears problematic. Technology development spillovers from using patent disclosures as sources of technical information are becoming much less significant. In part, this is because of the lack of use of readily-available patent information for technology development, the

---

[68] *See* Graham, et al., *supra* note __, at 1276.
[69] *Id.* at 1276.
[70] *Id.* at 1278.
[71] Graham, et al., *supra* note __, at 1283.
[72] *Id.* at 1285.
[73] *See, e.g.,* Atul Nerkar & Scott Shane, *Determinants of Invention Commercialization: An Empirical Examination of Academically Sourced Inventions,* 28 STRAT. MGMT. J. 1155, 1157-58, 1163-64 (2007). *See also* Scott Shane, *Technological Opportunities and New Firm Creation,* 47 MGMT. SCI. 205, 207-09, 216 (2001) (discussing importance and radicalness of the technology and the scope of patents to new firm creation).

inadequacy of patent disclosures, and the widespread availability of alternative sources of technical information.[74]

Similar uncertainties are posed for the alternatives to the traditional theories of the patent system, which focus on control of the technological "prospects" and on the ability to coordinate sequential innovation, dissemination, and technology transfer.[75] These uncertainties rise to serious concerns in regard to the development and transfer of needed technologies to developing country markets.

> Fundamentally, for technology transfer to take place in developing nations a number of obstacles must be overcome: uncertainty surrounding the costs and benefits of adoption, asymmetric information on the value of innovation, financial and skill requirements, externalities, and regulatory barriers…. The diffusion of new technologies is a difficult process, filled with uncertainty and hampered by both market and cultural factors…. [The literature] describes five characteristic[s] that affect technology diffusion: relative advantage, compatibility [with user values], complexity, triability [to overcome user uncertainty], and observability [of benefits … and] a number of [diffusion and adoption] factors [*i.e.,*] cost-effectiveness ... [and] access to investment capital [for capital intensive technologies having size and scale economies and] salvage values for the displaced technology across firms, as well as distinct abilities to assess the risks and rewards associated with the innovation…. Uncertainty and informational problems are exacerbated [in international policymaking contexts] and contracting solutions are more difficult to accomplish.[76]

---

[74] *See, e.g.,* Devlin, *supra* note __, at 403-04, 410 & n.50 (citing, *inter alia,* Jeanne C. Fromer, *Patent Disclosure,* 94 IOWA L. REV. 549, 560-62 (2009), and Christopher A. Cotropia & Mark A. Lemley, *Copying in Patent Law,* 87 N.C. L. REV. 1421, 1465 (2009)); Sean B. Seymore, *The Teaching Function of Patents,* 85 NOTRE DAME L. REV. 621, 624 & n. 12, 625-27 (2010) (patents rank third behind publications and informal exchanges in diffusing research and development) (citing Wesley M. Cohen, et al., *R&D Spillovers, Patents and the Incentives to Innovate in Japan and the United States,* 31 RES. POL'Y 1349, 1362-64 (2002)).

[75] *See generally* Edmund W. Kitch, *The Nature and Function of the Patent System,* 20 J. L. & ECON. 265 (1977); John F. Duffy, *Rethinking the Prospect Theory of Patents,* 71 U. CHI. L. REV. 439 (2004); F. Scott Kieff, *Coordination, Property, and Intellectual Property: An Unconventional Approach to Anticompetitive Effects and Downstream Access,* 56 EMORY L.J. 327 (2006).

[76] Daniel K.N. Johnson & Kristina M. Lybecker, Challenges to technology transfer: A literature review of the constraints on environmental technology dissemination, Colorado College Working Paper 2009-07, at 4-5 (July 2009), , available at http://ssrn.com/abstract=1456222 (citing, *inter alia,* Joe Tidd, Innovation Models, Imperial College London, Tanaka Business School Discussion Paper 1 (2006), available at http://ict.udlap.mx/projects/cudi/sipi/files/Innovation%20models%20Imperial %20College%20London.pdf); Amy Purvis & Joe Outlaw, *What We Know About Technological Innovation to Achieve Environmental Compliance: Policy Issues for an Industrializing Animal Agricultural Sector,* 77 AM. J. AG. ECON. 1237 (1995); and William Brock & M. Scott Taylor, Economic Growth and the Environment: A Review of Theory and Empirics, NBER Working Paper W10854, available at http://works.bepress.com/cgi/viewcontent.cgi?article=1035&context=taylor). *See generally* Dominique Foray, Technology Transfer in the TRIPS Age: The Need for New Types of Partnerships between the Least Developed and Most Advanced Economies (ICTSD May 2009).

Given these problems with disseminating patented technologies to developing countries, environmental and technology regulatory standards (which affect market prices) and direct market regulatory policies (including trade and competition policies and price regulation) have also been called into play as policy levers to promote technology development, dissemination, and transfer. But these additional measures either may complement or may contradict patent system invention, disclosure, and dissemination incentives. Accordingly, resolution of the best choices among the competing policies is not likely to occur theoretically, but only politically.

B. Unbalanced Worldwide Patterns of Innovation, Patenting, and Technology Transfer, and Resulting Tensions

Concerns over the patent system's role in promoting climate change technology development and dissemination are already acute in light of the importance and time-sensitivity of the need for these technologies. Yet, additional concerns will arise due to the unbalanced nature of worldwide innovation, patenting, and ownership, which may conflict contrast with the "common but differentiated responsibilities and respective" technological capacities, financial abilities, and climate change obligations of countries that has been recognized in the UNFCCC.[77] The UNFCCC obligates countries to cooperate in the "development, application and diffusion, including transfer, of technologies, practices, and processes,"[78] and more specifically notes the implementation by developing countries "will depend on the effective implementation" of developed countries to meet their commitments regarding financing and technology transfer.[79] Nevertheless, so far (and even in competitive markets) climate change technologies overwhelmingly are not licensed to developing countries, whether as the result of intellectual property or of other factors such as scientific capability, market conditions, and investment climate.[80] Of course, it is possible that in the future high greenhouse gas-emitting or energy-intensive technologies may disproportionately arise in or relocate to developing countries that lack strong climate control legal commitments (so-called carbon "leakage"), due to substitution effects or choices to off-shore production resulting from increased prices.[81]

Most patented mitigation and adaptation technologies are being developed in a very small group of developed countries (the so-called Big Three of Japan, Germany, and the United States),

---

[77] UNFCCC Convention, *supra* note __, Art. 3.1. *See id.* Arts. 3.2, 4.1-4.10.

[78] UNFCCC Art. 4.1(c).

[79] *Id.* Art. 4.7. *See* UNFCCC, Dec. 11, 1997, Kyoto Protocol To The United Nations Framework Convention on Climate Change, Art. 10, available at http://unfccc.int/cop3/resource/docs/cop3/protocol.pdf; UNFCCC, Report of the Conference of the Parties on its Thirteenth Session § 1.(d) (hereinafter "Bali Action Plan"), U.N. Doc. FCCC/CP/2007/6/Add.1, at 3 (Mar. 14, 2008) (recognizing the need for "[e]nhanced action on technology development and transfer"), available at http://unfccc.int/resource/docs/2007/cop13/eng/06a01.pdf.

[80] *See, e.g.,* Kaitln Mara, New Climate Technologies Rarely Reaching Developing Countries, Panel Says, IP Watch (July 13, 2010), available at http://www.ip-watch.org/weblog/2010/07/13/new-climate-technologies-rarely-reaching-developing-countries-panel-says; Mustapha K. Gueye, Technologies for Climate Change and Intellectual Property: Issues for Small Developing Countries, Information Note No. 12, at 1 (ICTSD Oct. 2009).

[81] *See, e.g.,* Mustafa H. Babiker, *Climate change policy, market structure, and carbon leaking,* 65 J. INT'L ECON. 421 (2005).

although some other developed countries (e.g., the United Kingdom and France, making the Big Five) and some emerging economies (the so-called BRICS-plus countries, which include Brazil, Russia, India, China, Mexico, and South Korea) are developing patented technologies in particular sectors such as energy generation, cement production and renewable energy sources.[82] As noted recently in a study that surveyed existing empirical data on patented climate change inventions, "the origins of applicants with the most patents are in OECD countries" and the surveyed studies "all suggest that companies from developing countries are facing some difficulties in obtaining technologies, whether it is the high cost of licensing or having to obtain technologies from second-tier technology holders."[83]

Between 1978 and 2003, most of the climate change mitigation technologies that were developed and patented in thirteen categories analyzed[84] (as measured by data from the EP/OECD World Patent Statistical Database) came from the Big Three, although in two categories (cement and certain renewable energy sources) the BRICS-plus countries were increasingly developing patented technologies.[85] In particular, China has been spending extensively on R&D and consequently has been patenting more extensively.[86] From 1998 to 2003, patenting of climate change technologies has grown on average by nine percent per year overall and eighteen percent for emerging economies.[87] The Big Three account for roughly sixty to eighty-five percent of all patented inventions in all categories measured.[88] Japan alone accounts for over fifty percent in three categories.[89] The data also suggest that such concentration is likely to perpetuate itself, as "[s]pecialization gains are seemingly important in climate change innovation."[90]

One recent effort to promote greater worldwide technology development that might expand the group of countries developing patented climate change technologies is an "Eco-Patent Commons."[91] In January of 2008, IBM, Nokia, Pitney Bowes, and Sony, in partnership with the World Business Council

---

[82] *See, e.g.,* Dechezleprêtre et al., *supra* note __, at 3-4 (citing China, South Korea, and Russia); Lee, Iliev & Preston, *supra* note __, at viii (focusing on Brazil, China, and India); UNEP/EP/ICTSD Study, *supra* note __, at 9, 30-36 (focusing on energy generation technologies, adding the United Kingdom and France to the Big Three and Korea in the top six, noting Mexico and Brazil for hydro-marine, and China being the next most important filing destination for actors in the top six countries, and identifying other developed and developing countries with significant patent activity for particular technology areas).

[83] UNEP/EPO/ICTSD Study, *supra* note __, at 23.

[84] The categories were wind, solar, geothermal, ocean, biomass, and hydropower renewable energy sources, waste use and recovery, methane destruction, climate-friendly cement, energy conservation in buildings, motor vehicle fuel injection, energy-efficient lighting, and carbon capture and storage.

[85] *See* Dechezleprêtre et al., *supra* note __, at 3-4, 6.

[86] *See, e.g.,* DR. YAHONG LI, IMITATION TO INNOVATION IN CHINA: THE ROLE OF PATENTS IN BIOTECHNOLOGY AND PHARMACEUTICAL INDUSTRIES 70 (Edward Elgar 2010) (citing twenty-percent annual filing increases since 2000, and changes to over sixty-percent of filings being domestic rather than foreign, as reflected in statistics from the State Intellectual Property Office).

[87] *See* Dechezleprêtre et al., *supra* note __, at 3-4.

[88] *See id.*at 18 & Table 3.

[89] *See id.* at 17.

[90] *Id.* at 4.

[91] *See* World Business Council for Sustainable Development, EcoPatent Commons, at http://www.wbcsd.org/templates/TemplateWBCSD5/layout.asp?type=p&MenuId=MTQ3NQ&doOpen=1&ClickMenu=LeftMenu.

on Sustainable Development, launched a patent pool allowing free access without reporting to a wide range of voluntarily contributed patents, in defined classes of environmentally friendly technologies, which included energy efficiency, recycling, waste reduction, and materials substitution.[92] In donating their patents to the Commons, contributors made a non-assertion pledge that reserved only the right to assert patents defensively if sued.[93] But the value, uptake, and innovation-promoting potential of these voluntary measures for climate change has yet to be demonstrated, particularly in the developing South.[94] "The biggest problem with the Eco-Patent Commons is its inability to attract the core innovation that may be needed to confront climate change. As the Council itself recognized, businesses will likely not donate patents that may give them a competitive advantage."[95]

In summary, the geographic imbalances in patenting behaviors and problems with and costs of technology acquisition for developing countries are likely to further exacerbate existing intellectual property, trade, and scientific differences and to generate political tensions along the North-South divide. Needed mitigation and adaptation technologies will have to be purchased by developing countries primarily from the Big Five and the BRICS-plus countries, which are historically responsible for or are currently making substantial contributions to carbon emissions, even if developing countries are increasing their share of such inventions.[96] Developing countries and international agencies funding technology deployment and dissemination are therefore likely to challenge patent rights that prevent lower-cost production and acquisition of such technologies, which may raise disputes under the TRIPS Agreement.[97] Or climate change technology-rich countries may adopt explicit or implicit export subsidies, which may generate additional trade disputes.[98] Conversely, technology-rich developed countries may seek to impose countervailing duties to balance the implicit subsidies reflected by production in less highly regulated emission jurisdictions, which may trigger disputes in the World Trade Organization ("WTO") under the Agreement on Subsidies and Countervailing Measures.[99]

---

[92] *See id.*
[93] *See* World Business for Sustainable Development, Eco-Patent Commons: Joining or submitting additional patents to the commons, at http://www.wbcsd.org/web/projects/ecopatent/EcoPatentGroundRules.pdf.
[94] *See, e.g.,* Bronwyn H. Hall & Christian Helmers, Innovation in clean/green technology: Can patent commons help? 25 (unpublished presentation June 2010 on file with the author).
[95] Deborah Behles, *The New Race: Speeding Up Climate Change Innovation,* 11 N.C. J. L. & TECH. 1, 20 (2009).
[96] *See, e.g.,* Hall & Helmers, *supra,* note __, at 23 (suggesting, based in part on the data analyzed by Dechezleprêtre et al., that technology developments for climate change may be more widely dispersed than in other areas).
[97] *See supra* note __ [Hall/Helmers & WG-LCA].
[98] *See, e.g.,* David A. Gantz & Padideh A'lai, Climate Change Innovation, Products and Services under the GATT/WTO System, in IP&CC RESEARCH HANDBOOK, *supra* note __ (discussing potentially actionable subsidies); Thomas L. Brewer, *The trade regime and the climate regime: institutional evolution and adaptation,* 3 CLIMATE POLICY 329, 338 (2003) (same). *See generally* WORLD TRADE ORGANIZATION & UNITED NATIONS ENVIRONMENT PROGRAMME, TRADE AND CLIMATE CHANGE WTO-UNEP REPORT (WTO 2009) (hereinafter "WTO-UNEP REPORT"); DUNCAN BRACK, MICHAEL GRUBB, AND CRAIG WINDRAM, INTERNATIONAL TRADE AND CLIMATE CHANGE POLICIES (Royal Institute of International Affairs 2000).
[99] World Trade Organization, Agreement on Subsidies and Countervailing Measures, (hereinafter "SCM Agreement"), Apr. 15, 1994, 33 I.L.M. __. *See* Gantz & A'lai, *supra* note __, at __; WTO-UNEP Report, *supra* note __, at 101.

The imbalances in innovation and patenting behaviors noted in the global studies of patenting behaviors are most likely to adversely affect the countries that are supposed to be helped by the UNFCCC process. As noted by economist Keith Maskus, to enhance diffusion of climate change technologies, developing nations are under pressure to reduce tariffs, but also to patent new technologies, which may impose a "double penalty" on local competition through imitation.[100] Further, these imbalances in local patenting may reflect differences in research and development ("R&D") budgets[101] and in the head-start that many developed countries already possess in scientific and technological development. The technological headstart is a particular concern in light of evidence that regional clustering of activities promotes both invention and innovation,[102] and of the consequent recent efforts – including proposed domestic funding from President Obama[103] – to consciously promote such clustering. Although increased R&D budgets globally may help, and are positively correlated with innovation and patenting behaviors for some climate change technologies, "disaggregated data on R&D budgets suggest that the role of R&D varies by technological field."[104] Climate change technology innovation thus appears sensitive to many kinds of policy, trade, and market factors – including market concentration and R&D feed-in tariffs, stages of technological maturity, R&D capabilities of licensing firms, importance of particular patents to licensing firms' portfolios and business plans, etc.[105] This complexity precludes simple recommendations to achieve desired innovation and technology outcomes.

In contrast to the comparative advantages that would lead to further extending the developed North's innovation and patenting head-start, international action on climate change may help to narrow the gap lead either through cooperative trade measures like trade-tariff exemptions or through cooperative technology development efforts, such as multi-national joint ventures or joint manufacturing for particular climate change technologies.[106] Similarly, international efforts may transfer technology directly to developing countries, through foreign funded in-country R&D, joint ventures, and foreign direct investment in R&D.[107] However, many obstacles exist to such foreign funded or participatory R&D that relies principally on market-based approaches, including significant fears of loss

---

[100] Maskus, *supra* note __, at 137.

[101] *See, e.g.,* Carlos M. Correa, *Review of the TRIPS Agreement: Fostering the Transfer of Technology to Developing Countries,* 2 J. World Intel. Prop. 939, 944 (1999) (noting that in 1999 only 4% of world R&D expenditures were from developing countries) (citing UNITED NATIONS DEVELOPMENT PROGRAMME, HUMAN DEVELOPMENT REPORT 1999 (Oxford U. Press New York 1999).

[102] *See generally* Mercedes Delgado, Michael E. Porter, Scott Stern, Clusters, Convergence, and Economic Performance (unpublished draft Aug. 2010), available at http://www.isc.hbs.edu/pdf/DPS_ClustersPerformance_08-20-10.pdf; Jonathan Sallet, Ed Paisley, and Justin Masterman, The Geography of Innovation: The Federal Government and the Growth of Regional Innovation Clusters (Sept. 2009), available at http://www.scienceprogress.org/wp-content/uploads/2009/09/eda_paper.pdf; MICHAEL E. PORTER ET AL., CLUSTERS OF INNOVATION: REGIONAL FOUNDATIONS OF U.S. COMPETITIVENESS (2001).

[103] *See, e.g.,* White House Office of Urban Affairs, Urban Update: Regional Innovation Clusters (Aug. 20, 2010), available at http://www.whitehouse.gov/blog/2010/08/20/urban-update-regional-innovation-clusters.

[104] UNEP/EPO/ICTSD Study, *supra* note __, at 37.

[105] *See id.* at 37, 43, 53-55.

[106] *See, e.g.,* Lee, Iliev & Preston, *supra* note __, at xi; UNEP/EPO/ICTSD Study, *supra* note __, at 21-23; Fair, *supra* note __, at 40-41.

[107] *See, e.g.,* Lee, Iliev & Preston, *supra* note __, at ix-x, 58; Elizabeth Burleson, *Energy Policy, Intellectual Property, and Technology Transfer to Address Climate Change,* 18 Transnat'l L. & Contemp. Probs. 69, 86 (2009).

of control over technologies protected by patents given the perceived lack of adequate enforcement of patent rights in developing countries.[108]

Global imbalances in patenting behaviors are also reflected in global imbalances in licensing and technology transfers from the developed North to the developing South. The climate change mitigation expenditures of developed countries adopted in Cancun are intended to benefit developing countries and thus may lead to significant subsidized deployment of advanced technologies in developing countries. But given the problems noted above, the Cancun Agreement may not necessarily lead to the required deployment of needed technologies, to development of technological capabilities, or to local invention and innovation in developing countries. Technology transfer typically occurs through trade, foreign direct investment ("FDI"), joint venturing, or licensing.[109] Although some historical and recent studies suggest that licensing and foreign direct investment, and consequently technology transfers, are positively correlated with stronger intellectual property rights,[110] recent studies of climate change technologies demonstrate that so far these technologies have not been widely licensed to developing countries (even to those having competitive markets). This may be the result of intellectual property ownership over those technologies in the developed North or of other factors, such as the lack of scientific capability, adverse market conditions, and poor investment climates in the developing South.[111]

One recent study concluded that the low rates of licensing of climate change technologies to developing countries were in general no lower than for other technologies although desires to license may be higher. But the magnitude of such licensing remained very low as a result of difficulties of identifying licensing partners, pricing, and geographic and exclusive scope provisions.[112] In contrast, a different study concluded that climate change mitigation technologies not only "are less likely to cross country borders than the average technology" (as measured by patenting in at least two countries), they also are principally transferred among developing countries (although transfers are increasing to developing countries). When such transfers do occur, they "seem to crowd out local innovations" (as imports for usage seem to substitute for domestic technology development).[113] Technology transfer flows thus are principally among developed countries (about seventy-five percent of exported inventions) and are "almost non-existent" between emerging countries.[114] Thus, the general pattern of low levels of technology transfer from the developed to the developing world is likely to remain stable for climate change technologies, or to skew even more strongly against flows to and among developing countries, even if funding from international agreements may potentially change these patterns.

---

[108] *See, e.g.,* Lee, Illiev & Preston, *supra* note __, at 8; Johnson & Lybecker, *supra* note __, at 7-9. *See generally* Peter K. Yu, *Enforcement, Economics and Estimates,* 2 W.I.P.O. J. 1 (2010).

[109] *See* Hall & Helmers, *supra* note __, at 7.

[110] *See, e.g., id.* at 11 (citing sources); Branstetter et al., *supra* note __, at 96-98 (citing sources).

[111] *See, e.g.,* UNEP/EPO/ICTSD Study, *supra* note __, at 58; Mara, *supra* note __.

[112] *See, e.g.,* UNEP/EPO/ICTSD Study, *supra* note __, at 9, 58-59.

[113] Dechezleprêtre et al., *supra* note __, at 4. *But cf.* Jean O. Lanjouw & Ashoka Mody, *Innovation and the International Diffusion of Environmentally Responsive Technology,* 25 RESEARCH POLICY 549, 549-71 (1996) (finding significant transfer of certain environmental technologies from the big three to fourteen developing countries).

[114] Dechezleprêtre et al., *supra* note __, at 4.

Some historical evidence also suggests that, as the strength of patents and the quality of their enforcement increases in developing countries, trade flows also increase to developing countries – in particular to those with high potential to imitate technology.[115] Similarly, some studies have shown that FDI tends to be positively correlated with stronger intellectual property protection for high technologies, although differences may exist between patents and trade secret protections.[116] Nevertheless, intellectual property protections are only one factor in a complex set of FDI considerations.[117]

Moreover, even without regard to the dramatic geographical imbalances in patenting and licensing behaviors, patented climate change technologies so far have taken very long times to reach the mass market and to achieve widespread diffusion.[118] As the recent effort to achieve a worldwide cell-phone standard has also demonstrated, patent rights may delay or interfere with coordinated approaches to achieve worldwide technology development and deployment.[119] And even when technology has been developed through R&D subsidies and transferred at low cost to developing countries, its use may require additional subsidies to overcome the sunk costs of existing infrastructure or equipment, and local adaptation (or invention) may be needed to provide sufficient comparative benefits to actual users,[120] given that the technology needs in developing countries may differ from

---

[115] *See, e.g.,* Hall & Helmers, *supra* note __, at 8-9 (citing, *inter alia,* P. Smith, *How do foreign patent rights affect U.S. export?,* 48 J. INT'L ECON. 151 (1999), and Keith E. Maskus & M. Penubarti, *How Trade Related Are Intellectual Property Rights?* 39 J. INT'L ECON. 227 (1995)). *See also* Maskus & Okediji, *supra* note __, at 7 (discussing studies showing increased licensing by and R&D spending by affiliates U.S. multinationals and to non-affiliates with implementation of patent reforms and increasing strength of local intellectual property protection, but only for large and middle-income emerging economies with the ability to adapt and compete).

[116] *See, e.g., id.* (citing, *inter alia,* Beata K. Smarzynska [Javorcik], *Does Foreign Direct Investment Increase the Productivity of Domestic Firms,* The World Bank Development Research Group, Trade (Oct. 2002), available at http://www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/2002/11/22/000094946_02111304010628/Rendered/PDF/multi0page.pdf; Walter G. Park & Douglas C. Lippoldt, *Technology Transfer and the Economic Implications of the Strengthening of Intellectual Property Rights in Developing Countries,* OECD Trade Policy Working Papers No. 62 (2008), available at http://www.oecd-ilibrary.org/trade/technology-transfer-and-the-economic-implications-of-the-strengthening-of-intellectual-property-rights-in-developing-countries_244764462745; John L. Turner & Paul Heald, IP & FDI, available at http://media.terry.uga.edu/myila/pdf/RRTurner.pdf).

[117] *See,e.g., id.* at 10 (citing sources).

[118] *See* Lee, Iliev & Preston, *supra* note __, at vii (e.g., 24 years on average in six categories including energy, photovoltaics, and carbon capture and sequestration (CCS)). *See also* WORLD BANK DEVELOPMENT REPORT, *supra* note __, at 293.

[119] *See, e.g.,* Branislav Hazucha, International Standards and Essential Patents: From International Harmonization to Competition of Technologies 27, 30 (2010) (noting one-year holdup of the W-CDMA standardarization process and oligopoly concerns), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1632567.

[120] *See, e.g.,* Hall & Helmers, *supra* note __ [article], at 4 (citing B. Agarwal, *Diffusion of Rural Innovations: Some Analytical Issues and the Case of Wood Burning Stoves,* 11 WORLD DEVELOPMENT 359 (1983), D.F. Barnes, et al., *The Design and Diffusion of Improved Cooking Stoves,* 8 WORLD BANK RESEARCH OBSERVER 119 (1993)). *See also id.* at 4-5 (discussing the "double externality" of environmental costs and incomplete appropriation of knowledge); *id.* at 24-25 (discussing difficulties of overcoming sunk costs, including high discount rates, large fixed costs, credit constraints, agency problems, and price uncertainties) (citing A.B. Jaffe & R.N. Stavins, *The energy paradox and the diffusion of conservation technology,* 16 RES. & ENERGY ECON. 91 (1994)).

those in developed countries.[121] Thus, relying on private markets and patents to distribute the needed technologies to the developing South may prove both costly and ineffective.

Substantial questions thus exist as to whether the patent system is up to the tasks of generating the needed technologies in the requisite timeframe and of assuring they are sufficiently available and affordable around the world. Given environmental externalities and needs, the social welfare costs of patents (by restricting competition, raising prices, and thereby depressing diffusion of needed technologies) may suggest that "patents may not be the preferred policy instrument for encouraging innovation in this area if they fail to create a competitive market for technology that leads to more diffusion than would be achieved in their absence."[122] But the world is embarked down the patent path, and whether a competitive market develops to make the needed technologies available and affordable will depend in large part on private marketing and licensing decisions as well as the underlying governmental patent and regulatory policies.

C. International Funding, Timing, and Transfer of Climate Change Technologies

In order to meet long-term climate control goals (currently pegged at no more than a two degree temperature rise above pre-industrial levels), worldwide cumulative low-carbon and energy-efficient technology investment needs are estimated at US$44 trillion by 2030.[123] Estimates for cumulative worldwide investment in energy infrastructure exceed US$16 trillion by 2030,[124] and trillions of dollars in transportation infrastructure are similarly estimated to be needed over the coming decades.[125] Median estimates for developing country climate change mitigation needs are US$400 billion per year until 2030, and for adaptation needs are US$75 billion per year until 2050.[126] In contrast to these levels, current world-wide development assistance (for which climate change adaptation costs are usually measured as incremental additions[127]) is around US$100 billion per year.[128] Public funding currently available for climate change mitigation and adaptation investments thus is well below the projected needs. Generating the needed funding will likely require development of additional public commitments, leveraged private money, and markets that set prices on carbon emissions.[129]

As a result of the Copenhagen Accord, and as formally agreed to in the Cancun Accord, developed countries have pledged short-term transfers of public funds to developing countries for mitigation and adaptation measures of $30 billion, with both public and private funding to increase

---

[121] *See id.* at 5-6.
[122] Hall & Helmers, *supra* note __ [article], at 5.
[123] Lee, Iliev & Preston, *supra* note __, at 3 (citing IPCC FOURTH ASSESSMENT REPORT, *supra* note __, and INTERNATIONAL ENERGY AGENCY, ENERGY TECHNOLOGY PERSPECTIVES (2008)).
[124] *See* Goulder & Pizer, *supra* note __, at 13.
[125] *See* WORLD BANK DEVELOPMENT REPORT, *supra* note __, at 6-7.
[126] *See id.* at 6-3, 6-5.
[127] *See id.* at 6-6.
[128] *See id.* at 6-3, 6-5.
[129] *See id.* at 6-5, 6-13, 6-17, 6-18.

these amounts by 2020 to US$100 billion per year.[130] These funds are supposed to help developing countries "to reduce emissions from deforestation and forest degradation (REDD-plus), [and with] adaptation, technology development and transfer and capacity building."[131] Numerous questions exist as to the sources of the funding, and whether they will be new and additional to funds that would already be expended, or will simply substitute for them in various ways.[132] Given the worldwide impacts of climate change, substantial additional funds will also be needed for similar mitigation and adaptation measures to be taken in the developed North, and the developing South will also need to supply additional funds to the contemplated wealth transfers from the North.

At least three competing models of innovation exist that affect the timing of these massive forthcoming expenditures: (1) learning by doing, or building off of experience; (2) inducing innovations through market, regulatory, and other incentives, evolutionary development, based on rules of thumb and routines that do not necessarily optimize R&D expenditures; and (3) spillovers from trade and technology transfers and from other (so-called disembodied) sources such as scientific conferences.[133] These different models have different implications for the policy and regulatory choices required to comply with international environmental regulation of carbon emissions. For example, an induced-innovation approach may suggest making regulatory compliance (and funding) decisions later, when the marginal costs of compliance have decreased due to induced technological innovation and diffusion. In contrast, a learning-by-doing approach may suggest greater early compliance expenditures so as to achieve such innovation.[134]

Even when innovation results in lower-cost and better technologies, numerous factors (including differential benefits from learning-by-doing and lock-in effects of using particular technologies) may inhibit widespread and rapid diffusion of those technologies to different classes of users.[135] Recent studies have suggested that policy interventions to create market demand and promote technology demonstration and deployment – and thus learning-by-doing – "can be a major accelerator of the innovation process," leading to rapid expansion of patenting in particular climate change technologies.[136] In turn, these patents (and other forms of intellectual property) "can be an important factor in determining the speed of technological demonstration and diffusion," even without

[130] *See, e.g.,* Cheryl Pellerin, Nations Advance on Climate Finance Outlined in Copenhagen Accord, America.gov, at http://www.america.gov/st/energy-english/2010/July/20100729144314lcnirellep0.1634027.html; UNFCCC Copenhagen Accord, *supra* note __, ¶ 8; UNFCCC Cancun Agreement, *supra* note __, at ¶¶ IV.A. 95, 98-99.

[131] Copenhagen Accord, *supra* note __,at ¶ 8.

[132] *See, e.g.,* J. Timmons Roberts, Martin Stadelmann & Saleemul Haq, International Institute for Environment and Development, iied briefing, Copenhagen's climate finance promise: six key questions (Feb. 2010), available at http://www.iied.org/pubs/pdfs/17071IIED.pdf.

[133] *See, e.g.,* Guy Jakeman et al., *Induced Innovations and Climate Change Policy,* 26 ENERGY ECONOMICS 937, 940-41 (2004) (describing various theories and citing analyses applying those theories); Adam B. Jaffe, Richard G. Newell & Robert N. Stavins, Technological Change and the Environment, Discussion Paper 00-47REV, at 34-39 (Resources for the Future Nov. 2001) (discussing evolutionary theories and citing analyses applying those theories).

[134] *See, e.g.,* Jaffe, Newell & Stavins, *supra* note __, at 33.

[135] *See, e.g., id.* at 41-64.

[136] Lee, Iliev & Preston, *supra* note __, at 57.

generating monopolistic behavior or barriers to entry.[137] Thus, even when government funding is used both to subsidize R&D efforts and to provide seed money for technology demonstration, continuing government direction of market developments may affect the rate of technology diffusion. Accordingly, government ownership decisions and retained rights in regard to patented technologies – such as the ability under the Bayh Dole Act for government funding agencies to retain title, to use the royalty free statutory license for public purposes, or to march in to license government funded patent rights to third parties[138] – may become an increasing focus of attention.

At least one practical case (although on a much smaller scale) exists from which to study the effects of the patent system and the effectiveness of treaty measures designed to achieve internally coordinated environmental benefits through technology development and transfer to developing countries. This is the Montreal Protocol's ban on chlorofluorocarbons ("CFCs") to protect stratospheric ozone, and the consequent need to develop technological substitutes for CFCs.[139] The Protocol created a fund to help developing countries phase out of CFC production, and required each Party to the Protocol to "take every practical step" consistent with funding mechanisms "to ensure that the best available, environmentally safe substitutes and related technologies [we]re expeditiously transferred" to developing countries, under "fair and most favorable conditions."[140] Unfortunately, a study of implementation of this provision has concluded that neither the financial assistance nor the technology transfer provisions were effective.[141]

> Efforts at acquiring substitute technology has not been successful as the technologies are covered by IPRs [intellectual property rights], and are inaccessible either on account of the high price quoted by the technology suppliers and/or due to the conditions laid down by the suppliers. This would require domestically owned firms to give up their majority equity holding through joint ventures or to agree to export restrictions in order to gain access to the alternative technology.
>
> Financial assistance towards the acquisition of such technology has also not been effective. In fact, an interim progress report by the Executive Committee on technology transfer stated that the terms of freely negotiated transfer of technologies, including costs such as patents, designs and royalties, may not always be accommodated by the funding policies of the Multilateral Fund. Thus, while prices of alternative technologies are unaffordable on account of IPRs, access to these is limited due to inadequate funds domestically and lack of financial assistance from the Multilateral Fund, creating a major

[137] *Id.*
[138] *See* 35 U.S.C. §§ 202(b)(1) & (c)(4), 203(a).
[139] *See* Arts. 10, 10A.
[140] Montreal Protocol, *supra* note __, Art. 10A(a)&(b).
[141] See Jayashree Watal, *India: The Issue of Technology Transfer in the Context of the Montreal Protocol,* in ACHIEVING OBJECTIVES OF MULTILATERAL ENVIRONMENTAL AGREEMENTS: A PACKAGE OF TRADE MEASURES AND POSITIVE MEASURES UNCTAD/ITCD/TED/6, at 46-55 (Jha, Veena and Ulrich Hoffman eds. United Nations April 2000). *See generally* STEPHEN O. ANDERSON, K. MADHAVA SARMA, & KRISTIN N. TADDONIO, TECHNOLOGY TRANSFER FOR THE OZONE LAYER: LESSONS FOR CLIMATE CHANGE (Earthscan 2007).

> hurdle in transiting to ODS [ozone depleting substance] friendly production, especially among producer nations.[142]

The failed example of technology transfer under the Montreal Protocol does not bode well for climate change, particularly given the narrow range of technological targets addressed, the limited funds that were provided, and the general consensus that existed regarding the appropriate nature of the task to be solved by the Protocol. The task of funding R&D for climate change and of assuring "common but differentiated" payment of the costs of adopting and disseminating the needed climate change mitigation and adaptation technologies will be incomparably more difficult.

As has been noted in other environmental regulatory contexts, where the causal mechanisms for achieving the required action are not specified, subsidiary implementation of centralized policies becomes difficult to achieve.[143] Like many other international agreements to transfer technology, the UNFCCC Convention and the Cancun Agreement fail adequately to address important issues, particularly in regard to patent rights and other intellectual property rights such as trade secrets. At the most basic level, the UNFCCC does not define technology transfer, although the Intergovernmental Panel on Climate Change (IPCC) has done so.[144]

Nevertheless, the UNFCCC Convention provide in Article 4.1(c) that all parties shall "promote and cooperate in the development, application and diffusion, including transfer, of technologies, practices and processes that control, reduce or prevent anthropogenic emissions of greenhouse gases not controlled by the Montreal Protocol in all relevant sectors, including the energy, transport, industry, agriculture, forestry and waste management sectors."[145] Under Article 4.2(e), Annex I Parties shall "coordinate as appropriate with other such Parties, relevant economic and administrative instruments developed to achieve the objective of the Convention."[146] Article 4.3 requires developed countries to provide financial resources "including for the transfer of technology, needed by the developing country Parties to meet the agreed full incremental costs of implementing" evaluation and mitigation measures agreed to by developing countries. [147]

---

[142] *Id.* at 45-46. *See* Martin Khor, IPRs, Technology Transfer, and Climate Change 4-6 (2009), available at www.un.org/esa/policy/devplan/egm_climatechange/khor.pdf.

[143] *See, e.g.,* Daniel P. Selmi, *Conformity, Cooperation, and Clean Air: Implementation Theory and Its Lessons for Air Quality Regulation,* 1990 ANN. SURV. AM. L. 149, 165, 166 & n.85, 173, 183 (describing costly intergovernmental bargaining that undermines achievement of federal goals, noting that the nature of statutory commands is the most significant factor for assuring attainment of those goals, and recommending various measures to improve shared implementation of federal policy); Joshua D. Sarnoff, *The Continuing Imperative (But Only From a National Perspective) for Federal Environmental Protection,* 7 DUKE ENVT'L L. & POL'Y FORUM 225, 261-63 (1997) (describing frictions, complexity, and accountability costs of intergovernmental implementation of centrally determined policies).

[144] Intergovernmental Panel on Climate Change, Methodological and Technological Issues in Technology Transfer, A Special Report of WG III (Cambridge University Press 2002) (defining technology transfer as "a broad set of processes covering the flows of know-how, experience and equipment …. [that] encompasses diffusion of technologies and technology cooperation across and within countries").

[145] UNFCCC Convention, *supra* note __, at Art. 4.1(c).

[146] *Id.*, Art. 4.2(e).

[147] *Id.* Art. 4.3.

The most detailed requirements appear in Article 4.5, which provides that:

> The developed country Parties and other developed Parties included in Annex II shall take all practicable steps to promote, facilitate and finance, as appropriate, the transfer of, or access to, environmentally sound technologies and know-how to other Parties, particularly developing country Parties, to enable them to implement the provisions of the Convention. In this process, the developed country Parties shall support the development and enhancement of endogenous capacities and technologies of developing country Parties. Other Parties and organizations in a position to do so may also assist in facilitating the transfer of such technologies.[148]

Article 4.7 recognizes that the effective implementation of developing country parties' commitments will depend on the effective implementation of developed countries obligations "related to financial resources and transfer of technology and will take fully into account that economic and social development and poverty eradication are the first and overriding priorities of the developing country Parties."[149] Articles 4.8 and 4.9, respectively, recognize "the specific needs and concerns" of developing countries and require parties to "take full account of the specific needs and special situations of the least developed countries in their actions with regard to funding and transfer of technology."[150] Finally, Article 11 provides for a financial mechanism to provide resources, including for transfer of technology.

Lacking any provisions in the UNFCCC Convention on technology transfer that are meaningfully more concrete than those of the Montreal Protocol, further specification by treaty development processes was inevitable. The Cancun Agreement thus specifies the minimum funding commitments to be supplied by the developed countries for transfer to developing countries (through mechanisms that have yet to be established).[151] It also provides somewhat more detail regarding the goals for technology transfer, and the process for accomplishing the treaty's technology transfer goals. Paragraph I.2.c. provides the general obligation on all parties to cooperate "through effective mechanisms, enhanced means and appropriate enabling environments, and enhance[d] technology development and the transfer of technologies to developing country Parties to enable action on mitigation and adaptation."[152] Paragraph IV.B.114 decides that technology needs must be nationally determined, and Paragraph IV.B.115 recognizes the many stages that are required for technology transfer to occur: "research and development, demonstration, deployment, diffusion and transfer of technology."[153] Further, the Cancun Agreement adopted a "Technology Mechanism" comprised of a "Technology Executive Committee" and a "Climate Technology Centre and Network."[154] The former is to implement the framework of technology transfer actions contemplated by Article 4.5 of the UNFCCC Convention,

---

[148] *Id.* Art. 4.5.
[149] *Id.* Art. 4.7.
[150] *Id.* Arts. 4.8, 4.9.
[151] *See supra* note __ and accompanying text.
[152] Cancun Agreement, *supra* note __, at ¶ I.2.c.
[153] *Id.* ¶¶ IV.B.115
[154] *Id.* ¶ IV.B.117.

according to defined priorities and performing specified functions.[155] The latter is to act as a Network to facilitate information sharing, action, and identification of needs among other "networks, organizations, and initiatives"[156] These measures are clearly a substantial improvement over prior, general commitments and treaty mechanisms, and the new entities clearly raise the profile of and institutionalize the technology transfer function. But their effectiveness has yet to be tested, the relationship of the Technology Executive Committee to the newly created Green Climate Fund[157] has yet to be established, and neither body has any authority to circumvent or affect national laws governing intellectual property rights. For the reasons described above, these new institutions will be put to the test – and soon.

D. Existing International Technology Transfer Measures and Proposals to Regulate Patents for Climate Change Invention and Technology Transfer

There is a long history – dating back at least to the United Nations Conference on Environment and Development in 1992 in Rio de Janiero where the UNFCCC was negotiated and adopted – of the developing world seeking to negotiate controls on intellectual property rights to promote technology transfer to environmentally sound technologies.[158] Even today, the United Nations continues to consider and recommend changes to the TRIPS Agreement to better assure transfer of climate change technologies.[159]

Article 7 of the TRIPS Agreement requires that "protection and enforcement of intellectual property rights should contribute to the promotion of technological innovation and to the transfer and dissemination of technology, to the mutual advantage of producers and users of technological knowledge and in a manner conducive to social and economic welfare, and to a balance of rights and obligations."[160] Article 8.2 authorizes member countries to take "[a]ppropriate measures" consistent with other provisions of the Agreement, where they are needed to address practices that "unreasonably restrain trade or adversely affect the international transfer of technology."[161] Article 66.2 requires developing countries to adopt domestic incentives to promote and encourage "technology transfer to least-developed country Members in order to enable them to create a sound and viable technology

---

[155] *Id.* ¶¶ IV.B.119-21.
[156] *Id.* ¶ IV.B.123.
[157] *See id.* ¶¶ 102-112.
[158] See, e.g., Khor, *supra,* note __, at 2; United Nations Department of Economic and Social Affairs, World Economic and Social Survey 2009, at 124 (2009) (hereinafter "UN WESS2009") (also noting emphasis on technology transfer of environmentally sound technologies in the 1972 U.N. Conference on the Human Environment in Stockholm and in the Buenos Aires Plan of Action adopted by the Fourth Conference of the Parties to the UNFCCC in November of 1998).
[159] *See, e.g.,* United Nations Department of Economic and Social Affairs, World Economic and Social Survey 2010, at xviii (2010) (hereinafter "UN WESS2010") (the TRIPS Agreement "will need to be revisited to allow for the affordable transfer of technologies to developing countries so as to enable them to adapt low-carbon and energy efficient production methods.").
[160] TRIPS Agreement, *supra* note __, Art. 7.
[161] *Id.* Art. 8.2.

base,"[162] and has not been well implemented by adoption of measures that specifically target transfer to developing countries.[163] The scope of these provisions and the meaning of consistency with the Agreement are unclear, but to date there have been few identified measures taken specifically to implement these provisions or to address any adverse effects of intellectual property rights on international technology transfers.[164] The one significant exception was the Doha Declaration, and the related, subsequent amendment to the TRIPS Agreement, that was adopted in order to facilitate compulsory licensing of medicines for export to developing countries that lacked the capacity to produce them (as a compulsory license for imports to those countries would be insufficient to assure low-cost supplies).[165]

As noted above, although intellectual property rights in general and patents in particular were substantial concerns in Bonn and Copenhagen, they receded from the focus in Cancun. Likely explanations include the political reality that achieving an agreement to take action was perceived to be an urgent need so as to save the UNFCCC process, the recognition that developed countries would not agree to regulation of intellectual property in the context of UNFCCC negotiations, and the promise of large amounts of money as wealth transfers from the developed North to address mitigation and adaptation needs of the developing South.[166] Nevertheless, given the technology needs, forthcoming funding flows, and massive wealth transfers that will result, many different aspects of the patent system and related legal doctrines have been and increasingly will be subjected to substantial scrutiny.

Past proposals for international regulation of patent law in the context of climate change have included: (1) imposing new restrictions on patent eligible subject matter for climate change technologies,[167] notwithstanding that the TRIPS Agreement requires patents to be available in all fields of technology[168]; (2) revising requirements for disclosure (to increase information), application processing (to reduce processing times), and patentability requirements such as the obviousness threshold (either to promote or to restrict such patents); (3) reducing rights and/or patent terms, including altering infringement standards or creating and exceptions and limitations; and (4) addressing

---

[162] *Id.* Art. 66.2.

[163] *See, e.g.,* Suerie Moon, Does TRIPS Art. 66.2 Encourage Technology Transfer to LDCs?: An Analysis of Country Submissions to the TRIPS Council (1999-2007), UNCTAD-ICTSD Project on IPRs and Sustainable Development, Policy Brief No. 2, at 5 (Dec. 2008), available at http://www.iprsonline.org/New%202009/Policy%20Briefs/policy-brief-2.pdf.

[164] *See, e.g.,* Oliva et al., *supra* note __, at 3.

[165] *See* Doha Declaration, *supra* note __; World Trade Organization, General Council Decision: Implementation of paragraph 6 of the Doha Declaration on the TRIPS Agreement and public health, WT/L/540, and Corr. 1 (Sept. 1, 2003), available at http://www.wto.org/english/tratop_e/trips_e/implem_para6_e.htm; World Trade Organization, Amendment of the TRIPS Agreement: Decision of 6 December 2005, WT/L/641, available at http://www.wto.org/english/tratop_e/trips_e/wtl641_e.htm.

[166] *See, e.g.,* Martin Khor, *Cancun meeting used WTO-type methods to reach outcome,* SUNS # 762 (Dec. 15, 2010), available at http://www.twnside.org.sg/title2/climate/info.service/2010/climate20101202.htm (views expressed by the Executive Director of the South Centre).

[167] *See, e.g.,* UN WESS2009, *supra* note __, at 130-31 (discussing required exemptions from patenting generally or only in developing countries, and authorizing developing countries to decide whether to exclude, and granting of voluntary licenses on request or automatically with compensation); *supra* note __ [WG LCA].

[168] *See* TRIPS Agreement, *supra* note __, Art. 27(1).

licensing, misuse, and antitrust concerns, including imposing compulsory licensing regimes.[169] Even those who foresee widespread international licensing of new climate change technologies at reasonable prices have argued for strict policing of antitrust laws to assure that vertical integration does not prevent competition, and for mandatory cross-licensing to assure technology development and compulsory licensing to protect businesses in developing countries that are capable of manufacturing such technologies.[170]

Although further amendment of the WTO TRIPS Agreement such as has been discussed by the United Nations[171] is a theoretical possibility if international concerns become more politically salient over time, consensus for such adopting such amendments at least in the short term is unlikely. Nevertheless, the rhetoric will (like the climate) become increasingly heated.[172] Without such treaty amendments, countries (particularly those in the developing South) will seek to make greater use of existing TRIPS flexibilities, and in doing so they will generate further tensions over intellectual property rights with developed North that may result in dispute proceedings in the WTO.[173] However, given the political difficulties of selectively applying in particular cases the flexibilities that exist in the TRIPS Agreement – such as compulsory licenses, regulation of voluntary licenses, and certain exceptions to patent rights – developing countries may be more likely to adopt broader but more administrable exclusions from patent eligibility, exceptions to patent rights, and alternatives to the patent system (such as a global technology pool) and expanded access to publicly funded technologies that may better promote technology development, transfer, and use.[174] These broader options may provide greater ex-ante predictability "in accessing technologies and [may] further enable much-needed research and development for local adaptation and diffusion, which would further reduce the cost of the technologies."[175]

---

[169] *See, e.g., supra* note __; Teneille R. Brown, *The Eminence of Imminence and the Myopia of Markets,* 9 THE JOHN MARSHALL REV. OF INTELL. PROP. L. 674, 690-91 (2010) (suggesting compulsory licensing, research exceptions from infringement, and exhaustion of patent rights in climate change technologies); Deborah Behles, *The New Race: Speeding Up Climate Change Innovation,* 11 N. CAR. J. L. & TECH. 1, 26-31, 34-40 (2009) (discussing application processing, and suggesting modified obviousness standards and patent terms, and expanded compulsory licensing) (citing Estelle Derclaye, *Intellectual Property Rights and Global Warming*, 12 MARQ. INTELL. PROP. L. REV. 263, 287–89 (2008); Natalie M. Durzko, *Using Intellectual Property Law and Regulatory Processes to Foster the Innovation and Diffusion of Environmental Technologies,* 20 HARV. ENVT. L. REV. 3, 14 (1996); and Peter Appel & T. Rick Irvin, *Changing Intellectual Property and Corporate Legal Structures to Promote the U.S. Environmental Management and Technology Systems Industry*, 35 B.C. ENVTL. AFF. L. REV. 397, 406 (2008)).

[170] *See, e.g.,* John H. Barton, Background Paper, International Diffusion of Climate Change Technologies in the Transport Sector 13-14, 19 (Chatham House (Apr. 14, 2008), available at http://www.chathamhouse.org.uk/publications/papers/view/-/id/723/.

[171] *See, e.g.,* UN WESS2009, *supra* note __, at 133-34.

[172] *Cf.* Maria J. Oliva, *Climate Change, Technology Transfer and Intellectual Property Rights: Key Issues,* in Trade and Climate Change: Issues in Perspective 62 (Aron Cosbey ed., International Institute for Sustainable Development 2008) (noting the "difficulties and vast political costs of modifications to the TRIPS Agreement").

[173] *See id.* at 130-32 (also noting flexibility in regard to compulsory licensing, exhaustion – including parallel importation – doctrines, and competition policy to define abuse of dominant position to reflect harm to public interests).

[174] *See* UN WESS2010, *supra* note __, at 97.

[175] *Id.*

Even if the patent system successfully develops and transfers significant new climate change technologies, serious social harms may still result if the technology pipeline does not timely meet the mitigation and adaptation needs. This may ultimately encourage developing countries to seek amendments to the TRIPS Agreement or to other international treaties, to force developed country governments to directly mandate low-cost access to technologies that are patented by those countries' nationals and corporations.[176] It may also result in reconsideration of the various alternatives and supplements to the patent system for developing and disseminating the needed climate change technologies, such as global demonstration programs, open innovation mechanisms (including technology prizes and platforms), model research and development agreements, improved operation and maintenance practices and training and organizational procedures, patent pools, and public databases on licensing activities.[177]

In summary, concerns regarding the patent system and related doctrines are likely to generate serious political disputes, which may spill over from the context of climate-change-specific technologies to more traditional technologies. This is particularly likely for traditional technologies that may indirectly affect greenhouse gas emissions and uptake or may exacerbate or mitigate climate change problems. In each context, the basic premises of the patent system as a means for incentivizing investment, invention, disclosure, development and dissemination of technology will be subject to serious theoretical, practical, and political challenges.

II. Critical National and Private Policy Levers to Mitigate the Adverse Effects of Patents for Climate Change Technologies

National governments will face continuing and substantial domestic pressures to limit the scope and costs of patent rights in order to assure access to climate change technologies at affordable prices, to develop local capacity, and to attract competitive invention and investment from countries other than those where the patented technology is controlled. The obvious alternatives to refusals to license technologies (particularly if owned by foreign firms) for further research and development or to high prices for access to those technologies are to regulate the activities directly, by adopting compulsory licenses or by imposing direct price regulations.[178] The indirect alternatives are to regulate such conduct

---

[176] Significant additional concerns will arise regarding any technologies that are kept as trade secrets, and government efforts to compel such transfers may impose liability as takings. *See, e.g.,* Sharon K. Sandeen, *Trade Secrets and Climate Change: Uncovering Secret Solutions to Global Warming,* in IP&CC RESEARCH HANDBOOK, supra note __, at __.

[177] *See, e.g.,* Lee, Iliev & Preston, *supra* note __, at xi-xii, 8, 60-61; Brown, *supra* note __, at 690-91.

[178] *See, e.g.,* Keith E. Maskus, *The Curious Economics of Parallel Imports,* 2 W.I.P.O. J. 123, 123-24(2010) (discussing price regulation and effects on parallel imports for pharmaceuticals). Although not addressed below, it bears noting that judicial refusals to grant injunctions and to provide only damages may act like a compulsory license, but without as strongly diminishing ex ante static or dynamic invention incentives. *See, e.g.,* Joshua D. Sarnoff & Christopher M. Holman, *Recent Developments Affecting the Enforcement, Procurement, and Licensing of Research Tool Patents,* 23 BERKELEY TECH. L. J. 1299, 1346-49 (2008) (discussing such discretion in regard to research uses and research tools). *See generally* Joshua D. Sarnoff, *Lessons from the United States in regard to the recent, more*

by treating restrictive licensing as a competition violation (*i.e.,* as an abuse of dominant position) or by treating the patents themselves as essential facilities.[179] These approaches will be highly controversial and may threaten substantial trade retaliation from the countries that have promised to transfer wealth and technology to the developing South, or may prompt technology and investment withholding by businesses in the developed North. Such direct or indirect regulation, moreover, may be largely ineffective in regard to assuring transfers of tacit knowledge.[180] Compulsory licensing, price regulation, and antitrust treatment has been repeatedly resisted by the United States and (somewhat less so) other developed countries, particularly in foreign markets where they do not bear the costs but reap the benefits of exports.[181] The developing South may be unwilling to resist such trade pressures, even if the threats and trade sanctions would be found illegal under WTO rules.[182]

The six measures proposed below seek to avoid resort to these highly controversial approaches, although compulsory licensing, competition policy, and price controls will remain available and may operate in the background to induce broader and lower-cost voluntary licensing behaviors. Rather, the measures focus on achieving the greatest benefits for climate change innovation in both the developed and developing world, in a manner that is generally recognized as consistent with existing international intellectual property treaty law. These measures thus promise a greater likelihood of being employed to develop the needed technologies while controlling the costs of supplying access to them and of transferring them to the developing South, particularly when the patent owners are unwilling to voluntarily adopt widespread and low-cost licensing approaches generally or for Southern markets that are lacking in sufficient funds or innovation capacities.[183]

---

flexible application of injunctive relief, in II RESEARCH HANDBOOK ON THE INTERPRETATION AND ENFORCEMENT OF INTELLECTUAL PROPERTY UNDER WTO RULES: INTELLECTUAL PROPERTY IN THE WTO (Carlos Correa ed., Edward Elgar Press 2010),

[179] *See, e.g.,* Jay Pil Choi, *Compulsory Licensing as an Antitrust Remedy,* 2 W.I.P.O. J. 74, 74-77 (2010). European Commn. Dec. of 13 May 2009, COMP/37.990 (Intel) ¶¶ 1749-53, available at http://ec.europa.eu/competition/ sectors/ICT/intel_provisional_decision.pdf**.** *But see* Verizon v. Trinko, 540 U.S. 398, 407-08 (2004) (holding that enforced sharing of infrastructure my reduce incentives for technology and commercial development and does not create an anti-trust violation except in very rare circumstances, which do not include unilateral refusals to deal).

[180] *See, e.g.,* Reichman, *supra* note __, at 253-57 (citing, *inter alia,* Robert C. Bird, *Developing Nations and the Compulsory License: Maximizing Access to Essential Medicines while Minimizing Investment Side Effects,* 37 J.L. MED. & ETHICS 209 (2009), and K. M. Lybecker and E. Fowler, *Compulsory Licensing in Canada and Thailand: Comparing Regimes to Ensure Legitimate Use of the WTO Rules,* 37 J.L. MED. & ETHICS 222 (2009); Lynn Mytelka, Technology Transfer Issues in Environmental Goods and Services: An Illustrative Analysis of Sectors Relevant to Air Pollution and Renewable Energy, Issue Paper No. 6, at 7 (ICTSD 2007).

[181] *Cf. id.* at 255 (discussing Canada's licensing for export to Rwanda); *supra* note 273 (discussing differences in regard to competition policies). *See generally* Alan Devlin & Michael S. Jacobs, *Antitrust Divergence and the Limits of Economics,* 104 NW U. L. REV. 253 (2010) (discussing policy differences between the U.S. and E.U.).

[182] *See, e.g.,* Reichman, *supra,* note __, at 258-59.

[183] *Cf.* Foray, *supra* note __, at 39 (focusing on national flexibility under the TRIPS agreement to limit or extend exclusive rights and to use legal institutions to reconstruct research and information commons); Oliva et al., *supra* note __, at 5-7, 59-61 (discussing exceptions to and standards for patentability, experimental use, and compulsory licensing, and competition policy); Maskus & Okediji, *supra* note __, at vii-viii, 26-27 (noting the likelihood of compulsory licensing and its relatively unsuccessful application to assure access to environmentally sound technologies; the need for new and open models of innovation and new methods of financing to avoid compulsory licensing; national discretion under the TRIPS Agreement to adjust intellectual property rights and make

Specifically, the first set of proposed measures focus on protecting basic research and sequential innovation and use, by assuring that significant additional creativity beyond basic scientific discovery is needed for patent eligibility and by assuring robust experimental use, reverse engineering, and inter-operability exceptions to permit basic science to proceed unfettered by patent rights, to allow scientific knowledge to flow to the developing South, and to permit downstream development and use of the creative patented technologies that do result.[184] The next set of proposed measures seek to assure that that upstream owners of patented climate change technologies retain various rights when licensing their commercial development, so as to assure continued R&D and low-cost access. These measures include retaining power to authorize experimental and "humanitarian" uses for climate mitigation and adaptation needs, to change the default resort from exclusive to non-exclusively licensing unless it has been demonstrated to be needed, and to clarify "march in" criteria to facilitate access when patent owners or their licensees fail to make the technology accessible at affordable costs. The final recommendation is to make greater use of exhaustion (parallel importation) of patented technologies, preferably on a regional rather than a full international level, when patent owners or their licensees voluntarily supply certain some markets at low costs, to achieve wider diffusion of the climate change technologies.

The basic premise of these measures is that they will best preserve the ability for both developed and developing countries to generate the needed, creative technologies and will be easier and less problematic for both the developed North and the developing South to adopt. By limiting the grant of rights to more creative applications and by making clear that the grant of the patent does not include the right to prevent research and sequential innovation, inter-operation, and transfers across jurisdictions, the most serious concerns for technology development, access, and capacity building can be avoided. By retaining ownership powers and by clarifying the grounds for exercising them, both public funders and private patent owners can minimize the concerns over adversely effecting ex-ante investment and innovation incentives that attend ex-post government regulation to accomplish the same goals. Investors and inventors will know the limits of the patent rights, and can decide in advance whether the rewards warrant the limitations and risks. Such measures thus will be both simpler and fairer than imposing ex-post regulatory constraints on broader ex-ante grants of rights, as the limits will have been effectively consented to by the funding recipients and patent licensees.[185]

Further, adopting such measures for climate change technologies should be less controversial and less threatening to the various patent system incentives than they would be for pharmaceuticals and other medical technologies. In the access to medicines context, massive investments are typically needed to recoup the costs of clinical trials (rather than of invention creation activity), copying costs are minimal, and first-mover advantages may therefore be insufficient to recoup investments.[186] It also

corresponding policy initiatives to supply incentives for development, use, and transfer; and differential terms for patent protection for differing technologies).

[184] *Cf.* Reichman, *supra* note __, at 1140-41 (noting the ability to use both experimental use exceptions as well as competition policy to assure access to multiple platform technologies for further research, innovation, and use).

[185] *Cf.* Ruckelshaus v. Monsanto Co., 467 U.S. 986, 1006 (1984) (implying government power to condition benefits on voluntary relinquishment of trade secret without creating a constitutional taking of property rights).

[186] *Cf.* Scherer, *supra* note __, at 22-23 (comparing commercial aircrafts to pharmaceuticals).

bears noting that investors and inventors do not need to recoup *all* of the positive spillovers of the inventions that they create and patent in order to be sufficiently motivated to invest time and effort in making them. As Mark Lemley has cogently noted, "[t]he effort to permit inventors to capture the full social value of their invention – and the rhetoric of free riding in intellectual property more generally – are fundamentally misguided. In no other area of the economy do we permit the full internalization of social benefits."[187]

A. Broad Patent Eligibility Exclusions for Basic R&D to Direct Innovation to More Creative Applications

Private investments are unlikely to be sufficient to fund the development of new approaches to climate change technologies that rely on discoveries of basic science.[188] Rather, "the market-based innovation system founded on [intellectual property rights] will need supplementation through public research support and public-private coordination in areas where the success of private R&D programmes in [environmentally sound technologies] is highly uncertain and markets are small."[189] Patent rights may be least needed and least effective for stimulating the needed scientific research, even if they may potentially be more effective in stimulating commercial development of new climate change technologies from such research. This was precisely the premise of the Bayh-Dole Act,[190] which provided patent incentives to universities and small businesses to induce them to develop federally funded basic discoveries into useful, and commercially significant, practical applications.[191]

For centuries and around the world, research discoveries of basic scientific principles, natural phenomena, and abstract ideas have been and remain excluded from the patent system.[192] Originating

---

[187] Mark A. Lemley, *Property, Intellectual Property, and Free Riding,* 83 Tex. L. Rev. 1031, 1032 (2005).
[188] *See, e.g.,* Maskus & Okediji, *supra* note __, at 29; Peter Drahos, *The China-US Relationship on Climate Change, Intellectual Property and CCS: Requiem for a Species?,* 1 W.I.P.O. J. 125, 128 (2009) (discussing Kenneth Arrow's seminal work on why markets would under-fund research, particularly basic research) (citing Kenneth J. Arrow, *Economic Welfare and the Allocation of Resources for Invention,* in THE RATE AND DIRECTION OF INVENTIVE ACTIVITY: ECONOMIC AND SOCIAL FACTORS (Princeton U. Press. 1962)).
[189] *Id.* at 30.
[190] *See* 35 U.S.C. §§ 200-12.
[191] *See, e.g.,* Charles McManis & Sucheol Noh, The Impact of the Bayh-Dole Act on Genetic Research and Development: Evaluating the Arguments and Empirical Evidence to Date, at 2-3 (Aug. 13, 2006) (citing DAVID C. MOWERY, ET AL., IVORY TOWER AND INDUSTRIAL INNOVATION: UNIVERSITY-INDUSTRY TRANSFER BEFORE AND AFTER THE BAYH-DOLE ACT IN THE UNITED STATES 87-93 (2004), and H.R. Rep. No. 106-129 (Part I) at 6, 2000 U.S. CODE CONG. & ADMIN. NEWS 1799, 1800 (2000)), available at www.law.berkeley.edu/files/mcmanis(1).doc.
[192] *See, e.g.,* Bilski v. Kappos, 130 S.Ct. 3218, 3225 (2010). *See also, e.g.,* Convention on the Grant of European Patents (hereinafter "EPC"), art. 52(2)(a)&(c), Oct. 5, 1973, 1065 U.N.T.S. 255, 13 I.L.M. 270 (("discoveries, scientific theories and mathematical methods;" and "schemes, rules and methods for performing mental acts, playing games or doing business, and programs for computers" are not patent eligible inventions); U.K. Patents Act 1997 (as amended), § 1(2)(a)&(c) (same); Code de la Propriété Intellectuelle, art. L611-10(2)(a) (excluding "[l]es découvertes ainsi que les théories scientifiques et les méthodes mathématiques"); Patentgesetz, Art. 1, Abs. (3), Satz 1 (excluding "[e]ntdeckungen sowie wissenschaftliche Theorien und mathematische Methoden"); Patent Act (Canada), § 27(8) ("No patent shall be granted for any mere scientific principle or abstract theorem"); Patent Law of the Peoples Republic of China 1984 (as amended), Art. 25(1)&(2) (excluding "scientific discoveries" and "rules

in Europe, these exclusions for science, nature, and ideas were premised both on religious beliefs and deontological moral concerns,[193] and corresponded to utilitarian beliefs that society was better off when scientific and natural discoveries were widely shared and free from patent property rights. As aptly put by the late 19th century patent law scholar William Robinson, "[t]o benefit by the discoveries of his fellow-men is thus not only a natural right, it is also the natural duty which every man owes to himself and to society; and the mutual universal progress thence resulting is the fulfillment of the earthly destiny of the human race."[194] By prohibiting patents on basic scientific and natural discoveries, a robust public domain of science, nature, and ideas developed, along with Mertonian norms of communal sharing in scientific research.[195] Governments also sent important expressive signals that private ownership of such basic discoveries would create both deontological and utilitarian moral harms (even if the scientific, natural, and abstract discoveries themselves were highly useful and socially beneficial).[196]

In the modern era, however, the scope of patentable subject matter has continuously expanded. Particularly in regard to biotechnology, concerns have been raised that broad, "upstream" patent rights on scientific, natural, and abstract discoveries (encouraged by the Bayh-Dole Act) are being created that dominate and prevent too much sequential innovation.[197] Further, such patent incentives may not be needed to fund and motivate these upstream discoveries, so granting patent rights only imposes

---

and methods for mental activities"); The Patents Act (India), 1970 (as amended), § 3(c) ("the mere discovery of a scientific principle or the formulation of an abstract theory or discovery of any living thing or non-living substance occurring in nature" are not patentable inventions); Brazil Industrial Property Law, Art. 10(I)&(II) ("discoveries, scientific theories, and mathematical methods" and "purely abstract conceptions" are not inventions). *See also* Japanese Patent Act, Art. 2(1) (invention defined as "the highly advanced *creation* of *technical* ideas *utilizing* the laws of nature") (emphasis added); Australia Patents Act 1990 (as amended), § 18(1)(a) (patentable inventions must be "a manner of manufacture within the meaning of section 6 of the Statute of Monopolies"); Nat'l Research Devp't. Corp. v. Comm'r of Patents, 102 CLR 252, 279 (1959) (products of nature are not patentable even if "the assistance of man may be invoked for their planting and cultivation").

[193] *See* Sarnoff, *supra* note __, at 40-47.

[194] WILLIAM C. ROBINSON, THE LAW OF PATENTS FOR USEFUL INVENTIONS, § 25, at 39 (Little, Brown 1890).

[195] *See, e.g.,* Peter Y.-H. Lee, *Inverting the Logic of Scientific Discovery: Applying Common Law Patentable Subject Matter Doctrine to Constrain Patents on Biotechnology Research Tools,* 19 HARV. J.L. & TECH 79, 84 (2005).

[196] *See, e.g.,* Timothy R. Holbrook, *The Expressive Impact of Patents,* 84 WASH. U. L. REV. 573, 575-81, 596-602 (2006) (discussing the signaling role of patents in communicating non-technical information, the expressive harms from useful patents on genes that imply that particular social groups are pathological, and the moral expression of banning patents on technologies without actually prohibiting their use); Clarisa Long, Patent Signals, 69 U. CHI. L. REV. 625 636-37 (2002) (discussing use of patent in signaling business information).

[197] *See, e.g.,* Rebecca S. Eisenberg, *Noncompliance, Nonenforcement, Nonproblem? Rethinking the Anticommons in Biomedical Research,* 45 HOUS. L. REV. 1059, 1084-85 (2008); Heller & Eisenberg, *supra* note __, at 698. *Cf. Reichman, supra* note __, at 1136 (citing Brett M. Frischmann, *An Economic Theory of Infrastructure and Commons Management,* 89 MINN. L. REV. 917, 995-97 (2005), for the problem of multiple patents and competition for exclusive rights in research platforms); Richard A. Epstein, *Steady the Course: Property Rights in Genetic Material,* in PERSPECTIVES ON PROPERTIES OF THE HUMAN GENOME PROJECT 153, 163, 166 (F. Scott Kieff ed., 2003) (noting differences between patents on upstream building-block resources and downstream substitutable products); Margo A. Bagley, *Academic Discourse and Proprietary Rights: Putting Patents In Their Proper Place,* 47 BOSTON COLLEGE L. REV. 217, 220-24 (2006) (discussing effects of the Bayh-Dole Act on academic secrecy and proposing measures to encourage disclosures).

corresponding social welfare losses.[198] Similar concerns about the breadth of upstream patents and the lack of need for patent incentives have also been expressed in regard to business method and software inventions.[199] Unless effectively checked, the expansion of patent eligible subject matter to science, nature, and ideas may prevent or unduly delay important climate change-related discoveries and their development into needed technologies. Accordingly, both the developed North and the developing South may wish to adopt expansive exclusions from patent eligible subject matter in regard to climate change science and mitigation and adaptation technologies.

The question is how best to build off of the existing exclusions for science, nature, and ideas (and in many countries also for business methods and computer programs[200]) that already exist. These exclusions have a long historic pedigree and widespread recognition, and thus they are almost certain to be considered TRIPS compliant. In fact, patents on science, nature, and ideas could be found contrary to "*ordre public* or morality,"[201] and thus expressly permitted to be excluded without regard to interpretation of the undefined term "invention." Expanding these exceptions to exclude climate change technologies, or environmentally sound technologies, however, may be more problematic.

Arguments over what should be excluded from or included within the patent system typically either treat certain kinds of creativity as outside of the patent system because insufficiently technological in character[202] or seek to restrict the meaning and scope of the three categorical exclusions for science, nature, and ideas themselves so as to avoid reliance on eligibility decisions.[203] The first approach may raise concerns under Articles 27.1 and 30 of the TRIPS Agreement, although the Agreement does not define "technology" when prohibiting discrimination based on the field of

---

[198] *See, e.g.,* Lee, *supra* note __, at 80-81, 103-04.

[199] *See, e.g.,* Arti K. Rai, John R. Allison & Bhaven N. Sampat, *University Software Ownership and Litigation: A First Examination,* 87 N.C. L. Rev. 1519, 1554 (2009) (discussing ability to extract rents and holdup development); Olson, *supra* note __, at 228-34 (discussing high incentives and low costs for invention of business methods, and arguing that patents for such methods are inefficient); Devlin, *supra* note __, at 425-32 (discussing internally consumed business methods that are sufficiently incentivized by competition and adequately protected by trade secrecy).

[200] *See, e.g.,* EPC, *supra* note __, Art. 52(2)(a) (also excluding mathematical methods); *id.* Art. 52(c) (excluding methods of performing mental acts, playing games, and doing business, and computer programs); *id.* Art. 52(d) (presentations of information).

[201] *See* TRIPS Agreement, *supra* note __, Art. 27.2.

[202] *See, e.g., Amicus Curiae* Brief of Center for Advanced Study and Research in Intellectual Property (CASRIP) of the University of Washington School of Law, and of CASRIP Research Affiliate Scholars, In Support of Affirmance of the Judgment in Favor of Respondent, at 13-20, Bilski v. Kappos, 130 S.Ct. 3218 (2010) (No. 08-964) (hereinafter "CASRIP Bilski Brief"); Opinion of the Enlarged Board of Appeal of 12 May 2010 in relation to a point of law referred by the President of the European Patent Office pursuant to Article 112(1)(b) of the EPC, Case G 003/08, ¶¶ 10.3, 10.4, 10.5, 10.7.1, 10.13.1, 12.2.1, 12.2.2, and 13.5.1 (hereinafter "EPC, Case G 003/08"). *See generally* John R. Thomas, *The Patenting of the Liberal Professions,* 40 B.C. L. REV. 1139 (1999); Alan L. Durham, *"Useful Arts" in the Information Age*, 1999 B.Y.U. L. REV. 1419 (1999); Dr. Kelvin W. Willoughby, *How Much Does Technology Really Matter in Patent Law? A Comparative Analysis of the Doctrines of Appropriate Patentable Subject Matter in American and European Patent Law,* 64 FED. CIR. B.J. 63 (2008).

[203] *See, e.g.,* Research Corp. Techs., Inc. v. Microsoft Corp., 627 F.3d 859, 868 (Fed. Cir. 2010). *See generally* Mark A Lemley, et al., *Life After Bilski,* __ STAN. L. REV. __ (forthcoming 2011), available at http://ssrn.com/abstract=1725009; Michael Risch, *Everything is Patentable,* 75 TENN. L. REV. 591, 591-93 (2008).

technology and accepts that nations may create limited exceptions to patent rights.[204] Nevertheless, TRIPS specifically authorizes exclusions from patent eligible subject matter on environmental grounds under Article 27.2.

> Members may exclude from patentability inventions, the prevention within their territory of the commercial exploitation of which is necessary to protect *ordre public* or morality, including to protect human, animal or plant life or health or *to avoid serious prejudice to the environment,* provided that such exclusion is not made merely because the exploitation is prohibited by their law.[205]

Presumably, climate change is a now recognized as a sufficiently serious problem that excluding patentability for environmental sound technologies that make significant contributions to climate change would help to avoid serious prejudice to the environment within the meaning of Article 27.2. However, Article 27.2 may contemplate only the prohibition of patents on inventions that also must be banned from the marketplace, due to their exacerbation of environmental problems, rather than their ability to mitigate such problems.[206] Even if Article 27.2 is not restricted to harmful technologies, it is unclear whether such technologies must entirely avoid serious prejudice or only assist (to varying degrees) in doing so. Further, in addition to the potential TRIPS conflict, a "*per se* exemption for technology on environmental grounds would be politically difficult,"[207] precisely because norms against the granting of patents for environmental technologies are much less strong than the norms against granting patents on science, nature, and ideas.

Unless and until Article 27.2 is tested, it will remain uncertain whether such climate-change technologies that are otherwise considered to fall within the scope of Article 27.1 may be excluded from the patent system. Of course, there is relatively little risk of experimenting with such exclusions from patent eligibility, as countries found to be in violation of the TRIPS Agreement on this ground could simply change their law prospectively to include the excluded technologies. And the TRIPS Agreement could also be modified to expressly permit such exclusions. Such a change was achieved to permit compulsory licenses for export of essential medicines, and is currently being discussed in regard to exclusions from the patent system in regard to TRIPS Article 27.3 for disclosures of origin of patents developed from biological resources without complying with prior informed consent and benefit sharing obligations under the Convention on Biological Diversity.[208]

However, an entirely different approach may be adopted that is clearly TRIPS-compatible and may provide greater protection against patent rights that would dominate sequential innovation and

---

[204] *Cf.* TRIPS Agreement, *supra* note __, Arts. 27.1, 27.2, 30.
[205] TRIPS Agreement, *supra* note __, Art. 27.2 (emphasis added).
[206] *See, e.g.,* Carlos M. Correa, Multilateral Agreements and Policy Opporutnities 11 (2008), available at http://policydialogue.org/files/events/Correa_Multilateral_Agreements_and_Policy_Opportunities.pdf.
[207] *See* Maskus & Okediji, *supra* note __, at 35.
[208] *See supra* notes __, __ and accompanying text; Catherine Saez, Patentable Subject Matter, IP Waiver for Health Discussed at WTO (March 2, 2011). *See generally* Joshua D. Sarnoff & Carlos M. Correa, Analysis of Options for Implementing Disclosure of Origin Obligations in Intellectual Property Applications (UNCTAD 2005), available at http://www.cbd.int/doc/meetings/abs/abswg-04/information/abswg-04-inf-02-en.pdf.

would tax dissemination of important climate change technologies. This approach is based on adopting a restrictive interpretation of the meaning of "invention" as used in Article 27.1. It should be entirely uncontroversial that the categorically excluded discoveries of science, nature, and abstract ideas are not considered inventions under Article 27.1 for which signatory countries must provide patents. The meaning of these categories thus could be interpreted expansively, even if to do so runs contrary to recent efforts to interpret these categories restrictively.[209] Although such an approach is to be encouraged, broad interpretations of the categorical exclusions is not sufficient.

Rather, patent eligible inventions should exclude merely limited but uncreative applications of new discoveries of science, nature, and ideas to new but analogous or limited contexts. Allowing such patents would permit the discoveries themselves to restrict sequential innovation, by contributing the creativity that would be rewarded through patent rights. Patents are not supposed to reward the scientific, natural, and abstract discoveries themselves.[210] To avoid this result, patent eligibility should require additional and different kinds and degrees of creativity beyond the discovery and its mere application, even if the application is highly useful.[211] To be eligible, an invention should reflect creativity *in the application* of the discovery. This approach should better promote the development of scientific and technological capacity, particularly for information flows to the developing South, as downstream research and sequential innovation will be less burdened by patents that *effectively* protect and reward upstream scientific, natural, and abstract discoveries. Patents on uncreative and limited applications may individually or cumulatively act much like patents on the discoveries themselves.[212]

Current American patent law doctrine – recently reiterated by the Supreme Court in the *Bilski v. Kappos* business method case – effectuates this invention in the application (or additional contribution) approach by adopting the legal fiction of treating new discoveries of science, nature, and ideas as if they were already known in the prior art.[213] Thus, new scientific and natural discoveries cannot be considered to contribute creativity to an invention claimed by an applicant. Rather, to be patent eligible, inventions that apply new (or existing) discoveries of science, nature, and ideas must reflect additional creativity that is sufficient and not analogous to the natural properties discovered; only such new *and* creative applications will obtain patent system rewards.[214] In this way, patent eligibility operates similarly to a threshold non-obviousness (inventive step) requirement.[215] Excluding the contribution of new discoveries from consideration (although not necessarily treating them as prior art) was once the approach adopted under the European Patent Convention, and while it has now been

---

[209] *See supra* note __ and accompanying text.

[210] *See, e.g., supra* note __ and accompanying text; Sarnoff, *supra* note __, at 4-5 (citing, *inter alia,* Hector M. Holmes, *Patent Rights for Scientific Discoveries by C.J. Hamson,* 45 HARV. L. REV. 1431, 1432 (1932), and C.J. HAMSON, PATENT RIGHTS FOR SCIENTIFIC DISCOVERIES 20-29 (Bobbs-Merill Co. 1930)).

[211] *See* Sarnoff, *supra* note __, at 21-40 (discussing the requirement for creativity in the application of excluded science, nature, and ideas as the historical requirement for patentable invention in the United States).

[212] *See id.* at 49-61 (discussing how the invention in the application approach avoids effective constriction of the public domain).

[213] *See* Bilski v. Kappos, 130 S.Ct. 3218, 3230 (2010).

[214] *See* Sarnoff, *supra* note __, at 21-40 (tracing the history of American patent law cases establishing such requirements).

[215] *See id.* at 61-63 (discussing the relationship of subject matter to non-obviousness).

rejected for eligibility decisions it is still employed when determining the existence of a sufficient inventive step.[216]

An important benefit of adopting the invention in the application approach or other excluded-contribution approaches to patent eligibility is to direct investment, invention, and disclosure towards more creative practical applications of basic science and natural discoveries.[217] These are precisely the kinds of inventions that are thought to be most in need of patent incentives. Conversely, denying patent eligibility not only to the underlying scientific discoveries but also to insufficiently creative applications of them,[218] restricts patent rights from discoveries and technologies (particularly important research tools or platform technologies) that either are least in need of patent incentives[219] or are most likely to create problems for further research and sequential innovation.[220]

Adopting such approaches should also assist the developing South in catching up on the scientific and technological head-start of the developed North, by preserving a robust public domain of science and of insufficiently creative technological applications of new scientific discoveries. As a practical and de facto matter, such exclusions from patent eligibility already largely exist in the developing South, given that many firms simply fail to obtain patent protection in those jurisdictions.[221] And as Jerome Reichman has argued, developing countries should adopt "relatively stringent eligibility standards covering subject matter, novelty, nonobviousness, and disclosure."[222] Excluding insufficiently creative applications from eligible subject matter is both the clearest and most efficient means of doing so,[223] although the same result could be achieved through more stringent inventive step requirements (for which scientific and natural discoveries may also be treated as if they were prior art).[224]

Limiting patent eligible inventions to more creative applications of basic discoveries may ultimately incur a TRIPS compatibility challenge, although such approaches should ultimately survive scrutiny. A test case for such heightened eligibility standards almost occurred in India in regard to pharmaceuticals. Novartis Corporation sought to challenge India's application of Section 3(d) of the

---

[216] *See, e.g.,* EPC, Case G 003/08, *supra* note __, ¶¶ 10.4 – 10.8.8.
[217] *See, e.g., id.* at 81-85.
[218] *See* Sarnoff, *supra* note __, at 5-8, 19-24.
[219] *See, e.g.,* Lee, *supra* note __, at 103-04.
[220] *See, e.g.,* McManis & Noh, *supra* note __, at 1 (summarizing expressed concerns over upstream patenting and sequential innovation); Lee, *supra* note __, at 83-84 (discussing concerns for scientific research from research tool patents, relating to the breadth of the claims and the lack of available substitutes for use in further research).
[221] *See, e.g.,* Maskus & Okediji, *supra* note __, at 7.
[222] Reichman, *supra* note __, at 1147-48. *See id.* at 1133.
[223] *See* Sarnoff, *supra* note __, at 67-80.
[224] *See, e.g.,* Dann v. Johnston, 425 U.S. 219, 220 (1976) (avoiding eligibility arguments, but reiterating the need to evaluate the differences between the prior art and the claim); Sarnoff, *supra* note __, at 62. *Cf.* Donald S. Chisum, Weeds and Seeds in the Supreme Court's Business Method Patents Decision: new Directions for Regulating Patent Scope (draft of Oct. 27, 2010), § I.C.4 (noting that the Supreme Court in *Bilski* could have relied on obviousness to reject the claims, as it did in *Dann* and as it could do for many "bio-medical discoveries" and claims resulting from "the application of known techniques to isolate valuable biological subject matter"), available at http://ssrn.com/abstract=1698633.

Indian Patent Act[225] to deny patent eligibility to Glivek, a beta-crystalline form of a known compound imatinib mesylate. Novartis sought a declaration that the Section 3(d) was both unconstitutional and in conflict with the TRIPS Agreement.[226] Although the Madras High Court upheld the constitutionality of the provision under Indian law, it refused to address the TRIPS Agreement contention, claiming it lacked jurisdiction and indicating that it would be more appropriate for the Dispute Settlement Understanding of the WTO to address TRIPS compliance.[227]

Nevertheless, the issue could arise again in regard to other denials of patent eligibility (which may be less contentious outside of the context of pharmaceuticals), and could be brought before either the WTO or national courts. Because the TRIPS Agreement does not regulate the minimal threshold of creativity for patents, such measures should ultimately be found TRIPS compliant, either as a matter of patent eligibility in regard to the definition of invention[228] or as a matter of non-obviousness (inventive step) doctrine.[229] Given the recognized importance of the ends of promoting innovation and the lack of theoretical agreement as to the best means to do so,[230] WTO panels are unlikely to second guess such national choices, particularly as they have sound, non-discriminatory justifications and strong normative grounding. Further, such categorical, ex-ante exclusions should not defeat the kinds of expectancy interests that are typically the basis for of concern when evaluating TRIPS-compliance in regard to exceptions to rights under Article 30, as they apply only to granted patents.[231] Such measures (unlike Section 3(d) of the Indian Patent Act) will be even more likely to survive TRIPS scrutiny if the higher creative thresholds are applied consistently across all fields of practical endeavor not normatively

---

[225] The Patents Act, 1970, No. 39, Acts of Parliament, 1970, §3(d)-(f), as amended by The Patents (Amendment) Act, 2005, No. 15, Acts of Parliament, 2005 (excluding from the definition of an "invention" "the mere discovery of a new form of a known substance which does not result in the enhancement of the known efficacy of that substance or the mere discovery of any new property or new use for a known substance or of the mere use of a known process, machine or apparatus unless such process results in a new product or employs at least one new reactant.").

[226] *See, e.g.,* Amy Kapczynski, Harmonization and Its Discontents: A Case Study of TRIPS Implementation in India's Pharmaceutical Sector, 97 Cal. L. Rev. 1571, 1590-93 (2009); Shamnad Basheer & T. Prashant Reddy, *The "Efficacy" of Indian Patent Law: Ironing Out the Creases in Section 3(d),* 5 SCRIPTED 232, 237 (2008); Janice M. Mueller, *Taking TRIPS to India – Novartis, Patent Law, and Access to Medicines,* 356 N.E. J. Med. 541, 541-42 (2007).

[227] *See* Novartis AG & Anr. v Union of India & Othrs., (2007) 4 MLJ 1153. *But cf.* Shamnad Basheer & T. Prashant Reddy, *'Ducking' TRIPS in India: A Saga Involving Novartis and the Legality of Section 3(d)* , 20 NATIONAL LAW SCHOOL OF INDIA REVIEW 131, 138-47 (2008) (criticizing the Court's reasoning regarding the lack of jurisdiction).

[228] *See supra* notes __-__ and accompanying text.

[229] *See, e.g.,* Basheer & Reddy, *supra* note __, at 147-48.

[230] *See supra* notes __-__ and accompanying text.

[231] *See id.* Art. 30 (the lack of protection cannot "unreasonably conflict with a normal exploitation of the patent" nor "unreasonably prejudice the legitimate interests of the patent owner"); Panel Report, Canada--Patent Protection of Pharmaceutical Products, WT/DS114/R, ¶¶ 7.54-7.57, 7.69 (Mar. 17, 2000) (adopted Apr. 7, 2000), available at http://www.wto.org/english/tratop_e/dispu_e/7428d.pdf (both criteria – normal exploitation and legitimate interests – must be evaluated and justified normatively). *See also* Max Planck Institute for Intellectual Property, Competition & Tax Law, Declaration on the Three-Step Test (2009) (supporting a flexible approach to the normative evaluations), available at www.ip.mpg.de.

excluded from the patent system (such as business methods and literary or artistic endeavor), even if the thresholds have differential practical applications in different fields.[232]

Of course, preventing patent system incentives from rewarding either basic scientific discoveries or uncreative applications of them will not resolve the problem of insufficient funding for basic research, particularly given the magnitude of climate change mitigation and adaptation needs. Thus, some prominent academics at Duke University have proposed an international agreement to increase (in a common but differentiated fashion) domestic funding of climate technology research and development, similar to international treaty obligations to reduce emissions that adversely affect climate.[233] Nevertheless, substantial financial and non-financial motivations already exist to generate such discoveries, including reputational and financial benefits of prestige, jobs, skilled labor assistance, and grant funding.[234] Ultimately, the Hartwell approach[235] or other approaches to increasing public expenditures on basic research may be needed.

B. Robust Experiment Use and Inter-Operability Exceptions

Perhaps the greatest concern with patents for new technologies is their ability to impose costs on or to preclude basic research and sequential innovation. For this reason, countries around the world typically adopt broad exclusions either for non-commercial and university-based research, or for research that will allow reverse engineering and development of clinical information for regulatory approval of pioneering and generic medical products.[236] To the extent that countries do not already have such exceptions to patent rights in their laws, they may be well advised to adopt them.[237] As Carlos Correa has argued,

---

[232] *See, e.g.,* Kapczynski, *supra* note __, at 1594-98 (discussing TRIPS compliance in regard to both subject matter and inventive step).

[233] *See* Jerome Reichman, et al., Intellectual Property Alternatives: Strategies for Green Innovation, Energy, Environment and Development Programme Paper 08/03, at 27 (Chatham House Dec. 2008) (citring Richard Newell, International Climate Technology Strategies, Discussion Paper 2008-12, Harvard Project on International Climate Agreements (Oct. 2008).

[234] *See, e.g.,* Lee, *supra* note __, at 103-04. *Cf.* Sarnoff, *supra* note __, at 58 (citing Harold Demsetz, The Private Production of Public Goods, 13 J. L. & Econ. 293, 295 (1970) (discussing property rights and public goods production); Brett M. Frischmann & Mark A. Lemley, *Spillovers,* 107 Colum. L. Rev. 257, 272-73 (2007) (same)).

[235] *See, e.g., supra* note __ and accompanying text.

[236] *See, e.g.,* 35 U.S.C. § 271(e); Merck KGAA v. Integra LifeSciences I Ltd., 545 U.S. 193, 202-08 (2005); Agreement Relating to Community Patents, Dec. 15, 1989, art. 27; European Council Directive 2004/27, art. 1.8(6), 2004 O.J. (L 136) 34 (EC) (amending Council Directive 2001/83 art. 10 (EC)); Das deutsche Patentgesetz [German Patents Act], § 11, available at http://www.gesetze-im-internet.de/patg/index.html; Bundesgerichtshof [BGH] [Federal Court of Justice] July 11, 1995, 1996 Neue Juristische Wochenschrift [NJW] 782 (785) (F.R.G.) (Klinische Versuche I [Clinical Trials I]), translated in [1997] R.P.C. 623; BGH Apr. 17, 1997, 1997 NJW 3092 (Klinische Versuche II [Clinical Trials II]), translated in [1998] R.P.C. 423. *See generally* Henrik Holzapfel & Joshua D. Sarnoff, *A Cross-Atlantic Dialog on Experimental Use and Research Tools,* 48 IDEA 123 (2008) ; Carlos M. Correa, International Dimension of the Research Exception, SIPPI Project (AAAS 2005), available at http://sippi.aaas.org/intlexemptionpaper.shtml.

[237] *See, e.g.,* Reichman, *supra* note __ at 1138.

> It is vital for society to ensure a sustained scientific and technological progress based on past innovations. The patent owner cannot be given the power to prevent new generations of innovators to rely on an invention that, in turn, was derived from the pool of knowledge available to the inventor. Innovators ought to have the possibility of using their predecessors' work to develop their own creative and inventive capacities.[238]

Patents on research tools pose particular concerns. Such patents may be infrastructural platforms for a broad and important range of new scientific activities, especially if they are merely non-creative applications of new scientific discoveries.[239] In 2005, the Supreme Court expressly refused to determine in the *Merck KGAA v. Integra LifeSciences I Ltd.* case whether the codified regulatory approval exception to patent infringement for medical product development and testing applied to patented research tools that were not themselves the subject of regulatory approval.[240] Since then, the Federal Circuit has held that the exception does not apply to such research tools.[241]

The primary market for research tools (and thus the investment, invention, and disclosure incentive) is normally basic scientific research, although such tools also may be used to investigate applications of such research. Thus, research tool patents may prevent basic research and sequential innovation, or at least may substantially raise development costs when the tools are licensed restrictively or at high prices.[242] Particularly for broad new patent prospects opened up by important scientific discoveries,[243] research tools may be necessary "gateways" to quickly exploring and falsifying or developing the novel scientific paradigm.[244] Without a broad research exception for research tools (or other technologies used for further, basic scientific exploration), research tool patents "threaten to stagnate normal science."[245]

Concern over the limited scope of the experimental use exception in the United States has grown over time, particularly in regard to genetic diagnostics, even if serious adverse effects so far have been averted in other scientific fields.[246] Although some problems such as delays and alterations of research have been noted and may be expanding, patent holders have generally been restrained in threatening or suing non-commercial researchers and consequently scientists have continued to engage

---

[238] Correa, *supra* note __, at 12-13. *See* Rudolph J.R Peritz, *Freedom to Experiment: Toward a Concept of Inventor Welfare,* 90 J. PAT. & TRADEMARK OFF. SOC'Y 245, 248 (2008) (noting how an "exaggerated profit logic that emerged in the 1980s came to justify this ban on independent experimentation and the need to "restore independent experimentation to its rightful role").

[239] *See* Holzapfel & Sarnoff, *supra* note __, at 131-32, 142-48; Frischmann, *supra* note __, at 995-97.

[240] *See* 35 U.S.C. § 271(e)(1); Merck KGAA v. Integra LifeSciences I Ltd., 545 U.S. 193, 205 n.7 (2005).

[241] *See* Proveris Scientific Corp. v. Innovasystems, Inc., 536 F.3d 1256, 1265-66 (Fed. Cir. 2008); Sarnoff & Holman, *supra* note __, at 1314-20.

[242] *But cf.* Devlin, *supra* note __, at 432-35 (arguing that broad experimental use exceptions would unduly interfere with ex ante creation incentives, and noting that patentees will not always refuse to license and are in any event incapable of detecting and preventing all unlicensed experimental uses).

[243] *See supra* note __.

[244] Peter Lee, *Patents, Paradigm-Shifts, and Progress in Biomedical Science,* 114 Yale L.J. 659, 692-93 (2004).

[245] Lee, *supra* note __, at 692-93.

[246] *See, e.g.,* Isaac Rabino, *How Human Geneticists in U.S. View Commercialization of the Human Genome Project*, 29 NAT. GENETICS 15 (2001); Mildred K. Cho et al., *Effects of Patents and Licenses on the Provision of Clinical Genetic Testing Services*, 5 J. MOLECULAR DIAGNOSTICS 3 (2003).

in widespread patent infringement.[247] In contrast to the United States, many other countries have broader experimental use and regulatory approval exceptions to patent infringement. The broadest exceptions (such as that adopted by Belgium) permit not only research on patented inventions and their use to design around them, but also research with the patented inventions including inventions intended to be research tools.[248]

Broad experimental use and regulatory approval exceptions are well established, and have already survived scrutiny under Articles 28 and 30 of the TRIPS Agreement.[249] In the so-called Canadian Bolar decision,[250] stockpiling during the patent term (i.e., competitive making of the patented invention for sale once the patent term expired) was held to unreasonably conflict with normal exploitation of patent rights and was not considered a limited exception to them. However, making and use of the patented product for investigation and testing to obtain regulatory approval, in order begin production to enter the market immediately after the patent term expired, was found not to conflict with normal exploitation.[251]

Although broad research exceptions such as that in Belgium should assure that patent rights do not prevent experimentation with and reverse engineering of the patented technologies, patent rights may still prevent the effective use of further inventions that need to interact with the patented technologies. This is particularly likely when the patented technologies are incorporated into standards or comprise physical or regulatory infrastructure. For example, significant concerns arose when Union Oil Company of California (Unocal) owned patents on a technology for reformulated gasoline that was incorporated into the standard for California's automobile fuel requirements.[252] For another example, commentators have noted the critical importance of data and software integration for climate assessments[253] and the need for interoperability in regard to the technology standards that are developing for the smart grid for electric power distribution.[254]

---

[247] *See, e.g.,* Sarnoff & Holman, *supra* note __, at 1320-31.

[248] *See, e.g.,* Belgian Patent Act, art. 28, § 1(b) (enacted Apr. 25, 2005), available at http:/www.ejustice.just.fgov. be/cgi/summary.pl; Geertrui Van Overwalle, *The Implementation of the Biotechnology Directive in Belgium and its After-Effects. The Introduction of a New Research Exemption and a Compulsory Licence for Public Health,* 37 INT'L REV. OF INTELL. PROP. & COMPETITION L. 889, 906-08 (2006); Holzapfel & Sarnoff, *supra* note __, at 157-60 (discussing research on and research with patented inventions); Strandburg, supra note __, at 100-35 (same).

[249] *See, e.g.,* Maskus & Okediji, *supra* note __, at 32.

[250] *Compare* Patent Act, R.S.C., ch. P-4, § 55.2 (1985) (Can.) *with* 35 U.S.C. § 271(e)(1) (which overturned the decision in Roche Prods. Inc. v. Bolar Pharms. Co., 733 F.2d 858, 863 (Fed. Cir. 1984)).

[251] *See* World Trade Organization, Panel Report, Canada--Patent Protection of Pharmaceutical Products, WT/DS114/R (Mar. 17, 2000); Holzapfel & Sarnoff, *supra* note __, at 175-79.

[252] *See, e.g.,* Reichman et al, *supra* note __, at 11 (discussing the Federal Trade Commission's allegations that Unocal's conduct violated Section 5 of the Federal Trade Commission Act).

[253] *See, e.g.,* Siri J.S. Khalsa, et al., The GEOSS Interoperability Process Pilot Project (IP3), available at http://capita.wustl.edu/capita/capitareports/091013_AQRS/AQRS/GEOSS/KhalsaEtal_2009_GEOSS_IP3_ IEEEGRS.pdf; R. Warren, et al., Development and illustrative outputs of the Community Integrated Assessment System (CIAS), a multi-institutional modular integrated assessment approach for modelling climate change, available at centaur.reading.ac.uk/2027/1/EMSFinalRevisedRW7.doc.

[254] *See, e.g.,* Michael A. Carrier, *Antitrust and Climate Change,* in IP&CC RESEARCH HANDBOOK, *supra* note __, at [14-15] (citing, *inter alia,* U.S. DEP'T OF COMMERCE, NAT'L INST. OF STANDARDS AND TECHNOLOGY, NIST FRAMEWORK AND ROADMAP

Given the importance of inter-operability, many commentators have suggested resort to the "essential facilities" doctrine in antitrust law, which can supply compulsory licenses to assure the ability to use or interact with such infrastructural technologies.[255] Similar concerns about standardization around patent rights have been raised in regard to the newly developing field of synthetic biology.[256] Such ex-post compulsory licensing measures are likely to be much more controversial than excluding from the ex-ante grant of patents the right to prevent reverse engineering and inter-operability. [257]

Reverse engineering has long been permitted under trade secret law in regard to patentable and unpatentable inventions, and is expressly permitted in regard to digital copyright laws.[258] There is no good reason why it should not also be expressly permitted in regard to patent rights. Many countries (including the United States) have implicitly adopted reverse-engineering and inter-operability (in the form of comparative testing) exceptions to their patent laws in regulatory approval exceptions that permit development of pioneering or generic medicines and products.[259] But reverse engineering and inter-operability exceptions should be adopted more generally. Even if they were limited to patented climate change technologies, they should survive TRIPS scrutiny just as the regulatory approval exceptions did.

So long as such exceptions from patent rights are limited only to reverse engineering and assuring inter-operability with the patented technology, they should not significantly affect ex ante investment, invention, and disclosure incentives. This is because any competitive technology that would incorporate the patented technology into products or processes placed in commercial use would have to license that technology. If it does not, it should not adversely affect but rather may expand the market for the patented technology. Reverse engineering and inter-operability exceptions may also

---

FOR SMART GRID INTEROPERABILITY STANDARDS, RELEASE 1.0 (2010), Energy Independence and Security Act of 2007, Pub. L. No. 110-140, 121 Stat. 1492, § 1305 (2007). GridWise Architecture Council, Mission and Structure (Aug. 2010), and Federal Energy Regulatory Commission, Smart Grid Policy, 128 FERC ¶ 61,060 [Docket No. PL09-4-000] (July 16, 2009)).

[255] *See, e.g.,* Reichman, *supra* note __, at 1137. *See generally* Aspen Skiing Co. v. Aspen Highlands Skiing Corp., 472 U.S. 585 (1985).

[256] *See, e.g.,* Reichman et al, *supra* note __, at 18.

[257] *Cf.* Devlin, *supra* note __, at 437 (supporting a right to reverse engineer patented technologies, but only for a particular sector – software – where patent disclosures have been recognized as providing inadequate information).

[258] *See, e.g.,* 17 U.S.C. §1201(f) (authorizing reverse engineering to assure program-to-program interoperability); Kewanee Oil v. Bicron, 416 U.S. 470, 476 (1974) (noting in the context of trade secret misappropriation that reverse engineering is "a fair and honest means of starting with the known product and working backwards to divine the process which aided in its development or manufacture."); Bonito Boats, Inc. v. Thunder Craft Boats, Inc., 489 U.S. 141, 160 (1989) (noting that the legitimacy of reverse engineering acts as a spur to develop patentable technologies). *See also* Pamela Samuelson, Reverse Engineering Under Seige 1-3, available at http://people.ischool.berkeley.edu/~pam/papers/CACM%20on%20Bunner.pdf; Donna L. Lee, *Reverse Engineering of Computer Programs Under the DMCA: Recognizing a "Fair Access" Defense,* 10 MARQ. INTELL. PROP. L. REV. 537, 561-71 (2006) (proposing and justifying a defense for reverse engineering to achieve inter-operability). *See generally* Chilling Effects, Frequently Asked Questions (and Answers) about Reverse Engineering, available at http://www.chillingeffects.org/reverse/ faq.cgi#QID188.

[259] *See, e.g.,* 35 U.S.C. § 271(e)(1); Chinese Patent Law (as amended 2008), Art. 69(5).

facilitate adoption of patented technologies into standards, as the standards then would not block the ability to interact and operate effectively with other technologies.

Such inter-operability exceptions, moreover, should prohibit efforts to avoid their application and to expand the *effective* scope of patent exclusion to unpatented technologies that needs to interact with the patented technology. Such expansion may be achieved through artfully drafted patent claims that would define infringement by claiming any interaction with the patented technology (e.g., by claiming processing of or transfer of information at or through an interface with the patented technology).[260] Similarly, the exceptions from patent rights should preempt contractual terms that would seek to defeat the ability to rely on the exceptions as a condition of gaining access to perform experimentation or reverse engineering.[261] Ample precedent exists for overriding contractual provisions to assure effectuation of patent law policies, in the famous *Lear v. Adkins* case prohibiting contractual licensee estoppels of challenges to patent validity given the important public interests in assuring invalid patents can be challenged.[262]

In summary, broad experimental use and inter-operability exceptions to patent rights should be less controversial than the common statutory requirement in many countries for "dependent patent" compulsory licenses, which allow patented sequential inventions that incorporate the dominant patented technology to be practiced over objections (or licensing demands) of the dominant patent owner.[263] Similarly, they should be much less controversial than governmental exercises of the power to supply markets (including research markets) with the patented technology directly or through authorized government contractors, so as to produce and supply technologies at lower costs than the patent holder is willing to offer – a so-called "government use compulsory license."[264]

Accordingly, countries in both the developed North and the developing South should consider adopting (if they don't already have them) broad experimental use and regulatory approval exceptions and reverse engineering and inter-operability exceptions to patent rights. By raising the bar for patent eligibility (or non-obviousness), countries may also provide additional space to reverse engineer inventions that are patented in other countries, either under less stringent "second tier" utility model or compensatory liability rights doctrines, and sequential innovators in those countries may similarly protecting their inventions under these less stringent rights.[265] The result is likely to be greater technology transfer as well as greater development of local scientific and innovation capacity in the developing South.

---

[260] *See, e.g.,* Daniel W. McDonald et al., Software Patent Litigation, at 4 (ABA Section of Litigation April 2006) (discussing API/protocol claims and graphical user interface claims for computers and software), available at http://euro.ecom.cmu.edu/program/law/08-732/Patents/SoftwarePatentLitigation.pdf.

[261] *See, e.g.,* Daniel Laster, *The Secret is Out: Patent Law Preempts Mass Market License Terms Barring Reverse Engineering for Interoperability Purposes,* 58 BAYLOR L. REV. 621, 644-57 (2006).

[262] Lear v. Adkins, 395 U.S. 653, 669-74 (1969). *Cf.* Medimmune, Inc. v. Genetech, Inc., 549 U.S. 118, 135-36 (2007) (finding standing for declaratory challenges to patent validity without having to breach patent license terms, but not addressing whether an express contractual restriction on such challenges would be enforceable under *Lear*).

[263] *See, e.g., id.* at 30; Reichman, *supra* note __, at 139.

[264] Reichman, et al., *supra* note __, at 31. *See, e.g.,* 18 U.S.C. § 1498(a).

[265] Reichman et al., *supra* note __, at 29-30.

C. Retained Research and Humanitarian Licensing Powers

In contrast to the previous measures, which focus on changing legal doctrines to protect basic research, sequential innovation, and inter-operability, public and private ownership powers and their exercise through contractual measures can largely accomplish the same goals. As Keith Maskus and Ruth Okediji have noted, contractual arrangements "govern the majority of inter-firm and intra-firm transfers of knowledge and technology in both domestic and international markets."[266] Thus, even without broad statutory experimental use and inter-operability exceptions from patent infringement rights, research tool and platform technology owners need not restrictively and expensively license or price their patented technologies. Private patent owners, or government agencies that permit private entities to take title to government funded inventions, could condition the grant or licensing of those ownership rights on contractual commitments not to enforce patents against experimental uses or uses for inter-operability purposes.[267] Thus, universities, which typically acquire title under the Bayh-Dole Act, are increasingly choosing to reserve rights to enable continued experimentation and to "ensure broad access to research tools."[268] Without resorting to an explicit change to patent law doctrines regarding the scope of granted rights or limits on infringement, these measures could produce a contractual "research commons" through "common-use" licensing. [269] This commons could extend not only to patented technologies but also to materials and databases of information and for purposes of reverse engineering and inter-operability.

In 2007, the Association of American Medical Colleges (AAMC) and various research universities adopted a set of principles (the "Nine-Points Document") for licensing of patented inventions (which often would be subject to the Bayh-Dole Act).[270] The first principle calls for retaining authority for universities to license their inventions to other non-profit and governmental organizations "for research and educational purposes, including research sponsored by commercial entities."[271] Similarly, the Nine-Points Document encourages university to retain authority "to transfer tangible research materials (e.g., biological materials and chemical compounds) and intangible materials (e.g., computer software, databases and know-how) to others in the non-profit and governmental sectors."[272] Since that time, most universities have adopted licensing agreements to assure that the universities themselves can continue to use their own, developed technology for non-commercial research and educational

[266] Maskus & Okediji, *supra* note __, at 8.
[267] *See, e.g.,* Peter Lee, *Contracting to Preserve Open Science: Consideration-Based Regulation in Patent Law,* 58 EMORY L.J. 889, 920-38 (2009).
[268] *See, e.g.,* National Research Council, Managing University Intellectual Property in the Public Interest 7 (National Academies Press 2010) (discussing In the Public Interest: Nine Points to Consider in Licensing University Technology (Mar. 6, 2007) (hereinafter "Nine Points Document"), available at http://www.autm.net/nine_points_to_consider.htm).
[269] David, *supra* note __, at 69. *See* About Science Commons, available at http://sciencecommons.org/about.
[270] Nine Points Document, *supra* note __.
[271] *Id.*at 2 (Point 1).
[272] *Id.*

activities.[273] Many universities have also retained similar licensing authority for other university and non-profit research and educational activities, and the Nine-Points Document expressly encourages universities to retain these powers for others.[274]

Retained rights of owners could also preserve authority to engage in so-called "humanitarian licensing" to assure access and to control prices when necessary to override sub-licensing, supply, and pricing decisions made by the owners' licensees.[275] Humanitarian licensing terms could be as broad as reserving rights for "meeting the needs of developing countries," or could be more specific triggers (which better avoid subsequent disputes) such as defining income levels, specifying subsistence uses, specifying geographic markets, identifying and segmenting markets by specific commercial and humanitarian activities, and even preventing the filing of patent applications in particular jurisdictions.[276] Increasing numbers of universities are adopting such humanitarian licensing policies to assure low-cost access,[277] and private foundations have also modeled so-called product development partnerships on market segmentation and on retaining rights to assured continued non-profit research and development, to supply low-cost access where it otherwise might not occur, and to achieve other important social goals.[278] As noted by Alan Bennett, such retained rights should not unduly interfere with ex-ante innovation and dissemination incentives. "Such goals are typically noncommercial and therefore do not directly impair the licensee's ability to commercialize the technology, but they may be important to ensure that the licensor can continue to meet other institutional objectives such as education, research, and public service."[279]

Implicit in this "retained rights" approach is the recognition that the funders and patent owners can condition any grants or licenses on preserving the authority to take action, even when the grantee

---

[273] *See, e.g.,* Sara Boettiger & Alan B. Bennett, *Bayh-Dole: if we knew then what we know now,* 24 NATURE BIOTECHNOLOGY 320, 321 (2006)

[274] *See id.;* Nine Points Document, *supra* note __, at 2 (Point 1).

[275] *See, e.g.,* Alan B. Bennett, *Reservation of Rights for Humanitarian Uses,* in I INTELLECTUAL PROPERTY MANAGEMENT IN HEALTH AND AGRICULTURE INNOVATION: A HANDBOOK OF BEST PRACTICES 41, 41(Anatole Krattiger et al. eds. 2007).

[276] *See id.* at 42; Ashley J. Stevens & April E. Effort, *Using Academic License Agreements to Promote Global Social Responsibility*, LES NOUVELLES – J. LICENSING EXECUTIVES SOC'Y INTL. 85, 91 (June 2008).

[277] *See, e.g.,* Lee, *supra* note __, at 981-82 (discussing the Universities Allied for Essential Medicines' Equitable Access and Neglected Disease License and the Association of University Technology Managers' group for Technology Managers for Global Health, and citing, *inter alia,* Bennett, *supra* note __, at 41-42 & Lita Nelson, The Role of University Technology Transfer Operations in Assuring Access to Medicines and Vaccines in Developing Countries, 3 YALE J. HEALTH POL'Y L. & ETHICS 301, 306–08 (2003)).

[278] *See, e.g.,* Carol Mimura, *Technology Licensing for the Benefit of the Developing World: UC Berkeley's Socially Responsible Licensing Program,* J. ASSOC. UNIV. TECH. MANAGERS 15, 17-24 (2007) (describing a three-party collaboration agreement between the Institute for One World Health, Amyris Biotechnologies, Inc., and the University of California Berkeley based on Bill and Melinda Gates Foundation funding that reserves education and research rights and differentiates licensing in developed and developing countries; also referencing other research, license, and collaboration agreements established through the Gates Foundation); Intellectual Prop. Task Force of the Cal. Inst. for Regenerative Med., Minutes of Regular Meeting 98 (Nov. 22, 2005), available at http://www.cirm.ca.gov/transcripts/pdf/2005/11-22-05.pdf (statement of Richard Klausner, former head of Global Health Programs at the Bill & Melinda Gates Foundation); Lee, *supra* note __, at 969-71.

[279] Bennett, *supra* note __, at 41. *See* Lee, *supra* note __, at 985 ("university licensing rarely generates significant revenues, so access objectives are not likely to sacrifice substantial profits").

or licensee would choose not to do so. So long as the grantee or licensee is willing to participate, such retained rights approaches should be less objectionable than ex-post compulsory "public interest" licenses that also can assure greater supply or lower prices than the patent holder is capable of providing or willing to offer.[280] And rather than starting at the most restrictive level and having to act to override action, the retained rights approach can start at the most permissive level and ratchet up the restrictions if there are insufficient grantees or licensees to accept the initially offered conditions. Such changes can be made much more quickly and readily in response to market conditions than trying to reverse broad initial grants of rights for full patent terms through ex-post regulation.

These governmental and non-profit sector policies can also signal the private commercial sector to take similar actions.[281] Where the government adopts voluntary licensing guidelines (such as NIH's encouragement to widely and non-exclusively license patented research tools created with federal funding), such measures can induce compliant private actions even when they are not capable of being directly enforced.[282] Such measures also send important normative signals regarding the propriety of the relevant conduct, which private firms then can take into account when considering socially responsible action. Similarly, universities can adopt "[p]atenting and licensing policies [that are] not predicated on the goal of raising significant revenue for the institution."[283] Significantly, corporate firms have substantial discretion to sacrifice profits so as to achieve important social welfare goals.[284] Thus, retained rights approaches may be adopted not only as a result of government policies and university decisions based on their upstream ownership, but also by private investors and commercial firms that acquire patents free from such upstream ownership constraints.

D. Presumptions of Non-Exclusive Licensing

Commentators have proposed various administrative and judicial powers to compel non-exclusive licensing.[285] Non-exclusive licensing has proven much less problematic than exclusive licensing, in that it permits widespread use of the patented technology and the technology is more likely to be competitively priced, even if such licensing does raise the costs of (or "tax") uses for research that would otherwise be free under broad experimental use exceptions.[286] But regulatory power to compel

---

[280] Reichman, et al., *supra* note __, at 31.

[281] *See, e.g.,* Peter Lee, *Interface: The Push and Pull of Patents,* 77 FORDHAM L. REV. 2225, 2229-32 (2009).

[282] *See, e.g.,* Best Practices for the Licensing of Genomic Inventions: Final Notice, 70 Fed. Reg. 18,413, 18,414 (Apr. 11, 2005).

[283] NAS Report, *supra* note __, at 5.

[284] *See, e.g.,,* Einer Elhauge, *Sacrificing Corporate Profits in the Public Interest,* 80 N.Y.U. L. Rev. 733, 735-47 (2005) (discussing managerial discretion in this regard under the business judgment rule, as well as efficiency gains by effectuating shareholder preferences). *See also* Perry E. Wallace, *Climate Change, Corporate Strategy, and Corporate Law Duties,* 44 Wake Forest L. Rev. 757, 758-60 (2009) (discussing the need for strategic corporate planning to address physical, regulatory, and liability risks).

[285] *See, e.g.,* Reichman, *supra* note __, at 1137.

[286] Anthony D. So, et al., *Is Bayh-Dole Good for Developing Countries? Lessons from the US Experience,* 6 PLOS BIOL. 2078, 2080 (2008). *See, e.g.,* Reichman et al., *supra* note __, at 15 (discussing the "liability rule" of a non-exclusive "take and pay" standard form contract adopted to permit use of the patented Cohen-Boyer recombinant DNA technology in the United States). *But cf.* Holzapfel & Sarnoff, *supra* note __, at 128 (noting the questionable

non-exclusive licensing is not needed if the default condition for acquiring title or licensing rights in government-funded and private inventions is to authorize non-exclusive licensing, except when it is first demonstrated that exclusive licensing is actually needed for commercialization. Accordingly, various commentators have recommended that developing countries when adopting Bayh-Dole Act equivalents should require that patents not be exclusively licensed unless it is clear in particular cases that doing so is necessary for commercialization.[287]

Further, as has been suggested particularly for genomic and proteomic research tools, even when exclusive licensing has been demonstrated to be needed, exclusive licensing may be limited to the specific needs, time frames, and anticipated markets for which such a demonstration has been made, retaining non-exclusive licensing powers for different, later, or unanticipated uses of patented technologies.[288] Exclusive licenses also may be made conditional on adequate working, supply, and pricing in regard to the technologies.[289] Presumptions of non-exclusive licensing may be particularly important to assure technology transfer to the developing South, as a worldwide presumption of exclusive licensing may not be needed given impediments to serving such markets.[290] Of course, those countries may be correspondingly more likely to prohibit exclusive licensing outright, although doing so may risk the kinds of retaliatory threats that have been generated by the exercise of compulsory licensing powers.[291]

Such changes to the presumption of exclusive licensing are clearly within the existing power of Bayh-Dole Act federal funding (and patent title) university and non-commercial organization recipients. The Federal Government also retains in such inventions a non-exclusive, royalty free worldwide license to practice the invention, which would include practice of a wide range of public uses and extends to government contractors.[292] This retained governmental non-exclusive license likely could be employed without any need for compulsory licensing or the exercise of "march in" rights (discussed below),[293] although employing such licenses for commercial development in competition with title holders (or their otherwise-exclusive licensees) would raise obvious ex-ante incentive concerns. It also may be within the

---

validity of the Cohen-Boyer patent, given unrestricted dissemination of information about the invention more than a year before filing).

[287] *See, e.g.,* So, et al., *supra* note __, at 2081.

[288] *See, e.g.,* Nine Points Document, *supra* note __, at 2-3 (Point 2). *See also id.* at 5 (Point 5) (encouraging a blend of field-exclusive and non-exclusive licenses to assure access to research tools).

[289] *See id.* at 3.

[290] *Cf.* Charles R. McManis & Jorge L. Contreras, *Catalyzing Technology Development Through University Research,* in IP&CC RESEARCH HANDBOOK, *supra* note __, at [23] (discussing for developing countries prohibiting exclusive license grants, requiring sublicensing for local production, retaining private march-in rights, and prohibiting filing of patent applications).

[291] *See supra* note __ and accompanying text.

[292] *See* 35 U.S.C. § 201(c)(4) ("license to practice or to have practiced for or on behalf of the United States"). *Cf.* 35 U.S.C. § 207(a)(2) (federal agencies are authorized to "grant non-exclusive, exclusive, or partially exclusive licenses … on such terms and conditions … as determined appropriate in the public interest").

[293] *See* Sarnoff & Holman, *supra* note __, at 1357 (discussing lack of consensus regarding the ability of government agencies to authorize third-party uses, with some agencies believing they have the power but NIH treating the issue as an open question) (citing Report of the National Institutes of Health (NIH) Working Group on Research Tools, App. D, http://www.nih.gov/news/researchtools/appendd.htm).

power of federal funding agencies to adopt regulations under the Bayh-Dole Act that would impose requirements on patent title recipients to non-exclusively or otherwise widely license third parties, or to impose such requirements in specific funding agreements, although a substantial administrative record would need to be developed and cumbersome procedures employed to effectuate such requirements.[294] In contrast, such requirements have been affirmatively adopted by relevant legal provisions in the case of California's Institute for Regenerative Medicine Initiative, which provides state grant funding for stem cell research.[295]

Other countries could clearly adopt similar approaches to non-exclusive licensing with government funded innovations. This is particularly important as government expenditures as a share of R&D tend to be larger in the developing South.[296] Such measures should also pose less concerns for the private sector than proposals to more routinely prevent patenting of government funded inventions in favor of alternatives to the patent system, such as placing the funded discoveries and inventions in the public domain, creating scientific commons, enabling collective management (such as through pooling arrangements), and fostering open-source innovation.[297] And as with retained powers, such governmental presumptions may also have important signaling and demonstration effects, inducing private commercial entities to adopt non-exclusive licensing policies, whether to obtain marketing and goodwill benefits that may ultimately increase revenues or simply to effectuate corporate or shareholder preferences.[298]

E. Expansive and Clearer March-In Criteria

Under the Bayh-Dole Act, federal agencies granting title to federally funded inventions retain the statutory right:

> to require the contractor, an assignee, or exclusive licensee of a subject invention to grant a nonexclusive, partially exclusive, or exclusive license in any field of use to a responsible applicant or applicants, upon terms that are reasonable under the

---

[294] *See* 35 U.S.C. § 202(f)(2) (funding agencies "shall not require the licensing of third parties under any such [funding agreement] provision unless the head of the agency determines that the use of the invention by others is necessary for the practice of a subject invention or for the use of a work object of the funding agreement and that such action is necessary to achieve the practical application of the subject invention or work object. Any such determination shall be on the record after an opportunity for an agency hearing," and are subject to judicial review). *Cf.* Lee, *supra* note __, at 1001-02 (suggesting that NIH should "formally consider requiring grantees to non-exclusively license NIH-funded inventions within developing countries").

[295] *See* CAL. CODE REGS. tit. 17, § 100306(b) (2009); Lee, *supra* note __, at 963-67.

[296] *See, e.g.,* ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT, MAIN SCIENCE AND TECHNOLOGY INDICATORS (2009). *See generally* Paul A. David et al., *Is Public R&D a Complement or a Substitute for Private R&D? A Review of the Econometric Evidence,* RESEARCH POLICY (Sept. 2009); RICHARD R. NELSON, NATIONAL INNOVATION SYSTEMS: A COMPARATIVE ANALYSIS (Oxford U. Press 1993).

[297] *See* Reichman, *supra* note __, at 1144 (citing So et al., *supra* note __, at 2082, BOYLE, *supra* note __, Janet Hope*, Open Source Genetics. Conceptual Framework,* in GENE PATENTS AND COLLABORATIVE LICENSING MODELS 171(Geertrui van Overwalle ed., 2009), and Esther van Zimmerman, *Clearinghouse Mechanisms in Genetic Diagnostics,* in GENE PATENTS AND COLLABORATIVE LICENSING MODELS, *supra,* at 63).

[298] *See supra* note __ and accompanying text;

> circumstances, and if the contractor, assignee, or exclusive licensee refuses such request, to grant such a license itself, if the Federal agency determines that such —
> (1) action is necessary because the contractor or assignee has not taken, or is not expected to take within a reasonable time, effective steps to achieve practical application of the subject invention in such field of use;
> (2) action is necessary to alleviate health or safety needs which are not reasonably satisfied by the contractor, assignee, or their licensees;
> (3) action is necessary to meet requirements for public use specified by Federal regulations and such requirements are not reasonably satisfied by the contractor, assignee, or licensees; or
> (4) action is necessary because the agreement required by section 204 has not been obtained or waived or because a licensee of the exclusive right to use or sell any subject invention in the United States is in breach of its agreement obtained pursuant to section 204.[299]

The power to march in, however, is subject to burdensome administrative and judicial appeals procedures.[300] For this reason, contractual approaches are both quicker and easier, although many of the procedural burdens could be eased and requests for judicial injunctions prohibiting the exercise of governmental march-in rights could be refused.[301]

This statutorily retained power to march in to compel third-party licensing or to directly authorize such licensing is highly controversial, as it can effectively act as an ex-post regulatory compulsory license. Accordingly, the NIH has rejected three petitions requesting NIH to grant march-in rights on patented medicines, based on concerns that it would act as a disincentive for investment in developing commercial products.[302] But unlike compulsory licensing, march-in rights are agreed to ex-ante by federal funding recipients and in theory should be less objectionable when exercised. The problem arises because of the lack of clarity and foreseeability regarding the criteria on which and circumstances in which march-in power will actually be exercised.

Federal funding agencies thus could develop such criteria up front, just as upstream owners can and are adopting such criteria contractually as retained rights.[303] The signaling effects discussed above[304] thus can run in reverse, from the private non-profit sector back to the public sector, and back down again. In adopting clearer march-in criteria, federal funding agencies would provide greater ex-

---

[299] 35 U.S.C. § 203(a).
[300] *See* 35 U.S.C. § 203(b); Arti K. Rai & Rebecca S. Eisenberg, *Bayh-Dole Reform and the Progress of Biomedicine,* 66 LAW & CONTEMP. PROBS. 289, 294 (2003).
[301] *See, e.g.,* Sarnoff, *supra* note __, at 57-60, 72-80 (discussing authority under the TRIPS Agreement and public interest considerations for judicial refusals to grant injunctive relief).
[302] *See, e.g.,* Sarnoff & Holman, *supra* note __, at 1358 (citing In the Case of Norvir® Manufactured by Abbott Laboratories, Inc. (Nat'l Insts. Health July 2, 2004), available at http:// www.ott.nih.gov/policy/March-In-Norvir.pdf [hereinafter Norvir®]; In the Case of Xalatan® Manufactured by Pfizer, Inc. (Nat'l Insts. Health September 17, 2004), available at http://ott.od.nih.gov/policy/March-in-xalatan.pdf; DETERMINATION In the Case of PETITION OF CELLPRO, INC. (Nat'l Insts. Health August 1, 1997), available at http://www.nih.gov/news/pr/aug97/nihb-01.htm); Lee, *supra* note __, at 929-30.
[303] *See supra* notes __-__ and accompanying text.
[304] *See supra* notes __-__ and accompanying text.

ante notice regarding when march-in rights would be exercised, which (because voluntarily engaged by funding recipients) should then be both fairer and less objectionable if and when the relevant conditions arise. And to the extent that the criteria adopted are too stringent, regulatory modification of them could likely occur in significantly shorter time frames than the average lifetime of patents, permitting voluntary modifications without resort to ex-post compelled changes.

Of course, defining clearer march-in criteria to address limited access or market prices would require a major change in existing policies. The NIH has repeatedly refused to exercise march-in rights even for essential medicines, when the patent holders or their licensees have willingly supplied the market albeit at prices that significantly restrict access.[305] Thus, federal agencies would need to specify more clearly the kinds of experimentation, product development, and market access problems that warrant market interventions. Although regulations adopting such criteria would not doubt be highly contentious, the developing experience in the private sector may supply useful guidance, and judicial review of agency rulemaking should assure fair, ex-ante development (which again can change over time). In contrast, applying the same march-in criteria retrospectively and selectively in particular cases would much more seriously pose incentive and fairness concerns, similar to compulsory licensing under other regulatory powers.

If such clarified march-in criteria were adopted by rule, any subject entity will (or should) have understood the conditions on which the rights would be exercised, and thus should (or could) either have avoided accepting the terms of the deal or have avoided creating the triggering conditions. For this reason, the exercise of march-in rights should not generate concerns similar to regulatory takings of constitutionally protected property, as there would be no “reasonable, investment-backed expectation” that the government would not engage in such action.[306] In any event, it is unclear that exercising such march-in rights (or issuing compulsory licenses) would create a deprivation of economic value sufficient to rise to the level of a regulatory taking (considering reasonable expectations), as the owner could still compete in the market or license others at somewhat lower prices.[307] And if and when march-in did occur for federally funded inventions, it also should not trigger concerns among private entities that their own patented technologies will be subject to similar constraints through compulsory licenses. Nevertheless, it could signal the normative desirability of such conditions, which may induce private entities to follow suit.

Both the developed North and the developing South can experiment with different criteria and thus with different defaults for triggering such march-in rights, as countries continue to adopt variants of the Bayh-Dole Act. In any event, the assumption of the Cancun Agreement is that most innovation will occur through private sector funding, and thus the exercise of march-in rights (unlike the potential exercise of compulsory licensing powers) should not affect most patent rights in climate change

---

[305] *See supra* notes __-__ and accompanying text. *Cf.* Lee, *supra* note __, at 931-32 (noting NIH willingness to adopt measures using “consideration-based” approaches rather than through a “traditional public law model”).
[306] Ruckelshaus v. Monsanto Co., 467 U.S. 986, 1006 (1984).
[307] *See, e.g.,* Penn Cent. Transp. Co. v. City of New York, 438 U.S. 104, 124 (1978); Palazollo v. Rhode Island, 533 U.S. 606, 630 (2001); Tahoe-Sierra Preservation Council v. Tahoe Regional Planning Agency, 535 U.S. 302, 334-43 (2002).

technologies. Accordingly, there should (in theory) be little fear of dramatic reductions in foreign direct investment or other technology transfer mechanisms as different policies are adopted or when march-in rights are exercised under those policies.[308] And, correspondingly, it will be the effects of the normative signals from such march-in criteria that may have the greatest impact.

F. Expansive Exhaustion (Parallel Importation) Criteria

Given the global nature of the technologies and problems to be addressed, disputes over patent exhaustion are very likely to arise in the climate change context.[309] Article 6 of the TRIPS Agreement precludes international regulation by the WTO of national policies to address the exhaustion of patent (and other intellectual property) rights by the placing of goods on sale or in use, so long as national treatment and most-favoured-nation treatment principles are respected. "For the purposes of dispute settlement under this Agreement, subject to the provisions of Articles 3 and 4 nothing in this Agreement shall be used to address the issue of the exhaustion of intellectual property rights."[310] Accordingly, nations will remain free to provide either or both international and domestic exhaustion effect to patented goods sold in foreign and domestic markets, permitting low-cost resale and transfers from markets or market segments where patent holders have voluntarily placed goods on sale.[311] To be fully effective, however, such domestic laws may also need to supersede contractual restrictions that would seek to avoid the exhaustion principles that would otherwise take effect under domestic laws, such as by limiting authority for certain kinds of sales or by treating contracts as licenses rather than sales.[312]

---

[308] *Cf.* Fair, *supra* note __, at 37 (posing concerns over loss of foreign direct investment from compulsory licensing).
[309] *See, e.g., Get ready for the clean tech IP boom,* 182 MANAGING INTELL. PROP. 40, 44 (2008).
[310] TRIPS Agreement, *supra* note __, Art. 6.
[311] *See, e.g.,* Maskus, *supra* note __, at 123-32.
[312] See, e.g., Shamnad Basheer & Mrinalini Kochupillai, *TRIPS, Patents and Parallel Imports In India: A Proposal for Amendment,* 2 Indian J. Intell. Prop. L. 63, 85 (2009) (proposing a change to Indian international exhaustion provision of its patent law to expressly override "any contractual stipulation to the contrary" and notwithstanding "the specific form of the transaction"); Quanta Computer, Inc. v. LG Electronics, Inc., 553 U.S. 617, 635-38 (2008) (finding domestic patent exhaustion from authorized sale of parts used in practicing patented methods, where patent holder had not expressly contractually restricted the sale of parts for use in combination with unauthorized parts); Maskus, *supra* note __, at 125 (discussing Japanese law that permits parallel imports except where restricted by explicit contract provisions); Christopher B. Conley, *Parallel Imports: The Tired Debate of Exhaustion of Intellectual Property Rights and Why the WTO Should Harmonize the Haphazard Laws of the International Community,* 16 TUL. J. INT'L & COMP. L. 189, 204-08 (2007) (discussing competition policy regulation of contractual restrictions on international exhaustion). Cf. Jazz Photo Corp. v. International Trade Commission, 264 F 3d 1094, 1105 (Fed Cir 2001) (rejecting international exhaustion under U.S. patent law); Omega S.A. v. Costco Wholesale Corp., 541 F.3d 982 (9th Cir. 2008) (finding no exhaustion for goods manufactured and first sold abroad, under U.S. copyright law providing exhaustion for goods "lawfully made under this title") (citing 17 U.S.C. § 109(a)), aff'd by equally divided court, 131 S.Ct. 565 (2010); supra note __ and accompanying text. See generally Yina Dong, A Patent Exhaustion Exposition: Situating Quanta v. LGE in the Context of Supreme Court Jurisprudence, 2010 STAN. TECH. L. REV. N2, ¶¶ 23-62 (discussing competing interpretations of Quanta and the complex case law addressing the relationship of contractual prohibitions on exhaustion to patent misuse); Ako Shimada Williams, *International Exhaustion of Patent Rights Doctrine: Is Japan's Move a Step Forward or Back from Current Harmonization Effort?,* 7 J. INT'L L. & PRAC. 327, 331-34 (1998) (discussing the uncertain status of international exhaustion by first sale

It is much more debatable whether such parallel importation policies could permissibly apply to goods produced in jurisdictions where patent protection either is not obtained or is not available (even assuming such national patent policies are TRIPS compliant) and the goods are then imported into jurisdictions where it is patented. This scenario is of particular concern where production and first sale is by a third party unrelated to the patent holder, as the patent holder then will not have voluntarily supplied the goods in the unpatented market. The current Indian patent law may provide for such parallel imports. The current law liberalized restrictions under the earlier international exhaustion provision, which had prevented imports of goods that were purchased in foreign jurisdictions from legally (but not patent-holder) authorized resellers (typically due to national exhaustion in the foreign country). The current law, in contrast, makes international exhaustion turn only on authority "under the law to produce and sell or distribute the product" in the foreign jurisdiction, and presumably "the law" refers to the law of that foreign jurisdiction.[313]

For third party sales in foreign jurisdictions where no corresponding patent exist, the patent holder is not being deprived of any rewards to which it is entitled from the manufacture and sale of unpatented goods in such markets. Thus, Article 6 arguably should apply to permit imports from such jurisdictions, notwithstanding domestic patent rights. Differentiating the goods for exhaustion purposes based on the national patent policies of different jurisdictions also might conflict with the most-favored-nation treatment obligation of TRIPS Article 4.[314] On the other hand, to permit exhaustion in such cases arguably would impose on the patent holder too great a deprivation of the "import" right of Article 28.1 to qualify as a permissible exception to patent rights under Article 30. This is true even though a footnote to Article 28.1 subjects the right of importation to Article 6, and Article 5 makes clear that Article 6 applies to exhaustion principles (which could then be understood to be limited to circumstances of first sale by the patent holder).[315]

In cases of third-party sale in patent-free jurisdictions, the patent holder will not have authorized the production or sale and will not have obtained *any* remuneration in regard to the goods manufactured and sold, and thus would be treated even worse than simply granting a compulsory license to permit imports. To minimize the likelihood of this result, patent holders would be required to

abroad under U.S. law) (citing Boesch v. Graff, 133 U.S. 697, 702-03 (1890), and Curtiss Aeroplane & Motor Corp. v. United Aircraft Eng'g Corp., 266 F. 71, 72-80 (2d Cir. 1920)).

313 *See* The Patents Act, 1970, No. 39, Acts of Parliament, 1970, §107(A)(b), as amended by The Patents (Amendment) Act, 2005, No. 15, Acts of Parliament, 2005; Basheer & Kochupillai, *supra* note __, at 64, 74-75.

314 *See* TRIPS Areement, *supra* note __, Art. 4 (requiring any "privilege or immunity," which international exhaustion may be thought to convey, that is granted to nationals of any Member country to be granted to nationals of all Member countries). *Cf.* John H. Barton, *The Economics of TRIPS: International Trade in Information Intensive Products,* 33 GEO. WASH. INT'L L. REV. 473, 495 (2001) (arguing in favor of derogating from most-favored-nation principles to permit differential international exhaustion among source countries in different tiers of income); Basheer & Kochupillai, *supra* note __, at 79-81 (arguing that the Indian law should be construed to apply only where the goods are patented in both jurisdictions, but noting that such an interpretation would prevent international exhaustion where the patent holder placed the goods on sale in an unpatented jurisdiction).

315 *See* TRIPS Agreement, *supra* note __, Arts. 6, 28.1, 30; Basheer & Kochupillai, *supra* note __, at 77-78 (arguing that Article 5 of the TRIPS Agreement makes clear that Article 6 applies to exhaustion, which only applies to first sales by patent holders, and thus such imports would violate Article 28 and would not be a limited exception under Article 30).

seek patent rights in all countries where they might be obtained.[316] In contrast, international exhaustion after first sale by the patent holder will at least provide initial compensation at a price the patent holder was willing to voluntarily accept. Thus, WTO dispute processes might be likely to find a TRIPS violation. But even if they did so, countries adopting such aggressive international exhaustion policies not tied to first sales by the patent holder or its licensees would need only to revise their laws and prospectively come into compliance.[317]

Nevertheless, adopting such broad international exhaustion approaches may not be a good policy, either for the developed North or for the developing South. First, as with ex-post compulsory licensing, adopting such exhaustion selectively for particular technologies would likely invite trade retaliation.[318] Further, aggressive international exhaustion doctrines may ultimately impose greater costs than benefits, not only based on their potential to diminish ex-ante innovation incentives but also for the potential to acquire patented technologies at lower costs. The empirical literature on international exhaustion suggests that its economic effects are highly complex and heterogeneous across technologies. Specifically, the evidence suggests that there are costs to research, development, and deployment of technologies of preventing price arbitrage across jurisdictions through international exhaustion, but that there may be gains to research, development, and deployment if prices for the goods are regulated in the relevant markets.[319] Price regulation, however, also is highly controversial and is much less likely to be adopted for the broad range of climate change mitigation and adaptation technologies than it has been for pharmaceuticals and other medical products.

Further, although parallel imports may help countries to obtain specific technologies at affordable prices, it may also exert a more general upward pressure on prices for the same and other needed technologies, precisely because suppliers can no longer rely on price arbitrage in different markets.[320] For this reason, permissive regional exhaustion approaches should be found preferable to full international exhaustion. Such regional exhaustion permits arbitrage but only across relatively similar markets having comparable market structures and abilities to pay. It thereby permits price discrimination globally in ways that should better avoid diminishing both ex-ante innovation incentives and willingness to supply markets in the first instance.[321]

Creating such regional exhaustion approaches would be extremely difficult, given the need both to coordinate exhaustion policies of countries under their national laws and the lack of existing governance mechanisms to do so outside of existing trade regions (such as the European Union). International coordination of the exhaustion markets and regions through a newly developed treaty mechanism is therefore needed, which would only occur through the kinds of contentious international

---

[316] *See, e.g.,* Christopher Heath, Parallel Imports and International Trade 11 (International Association for the Advancement of Teaching and Research in Intellectual Property (ATRIP) Annual Meeting 1999), available at http://www.wipo.int/edocs/mdocs/sme/en/atrip_gva_99/atrip_gva_99_6.pdf
[317] *See supra* note __ and accompanying text.
[318] *See supra* note __, and accompanying text.
[319] *See, e.g.,* Maskus, *supra* note __, at 132.
[320] *See, e.g.,* Reichman, *supra* note __, at 1147.
[321] *See, e.g.,* Barton, *supra* note __, at 495 (arguing for tiered markets to allow gray market parallel trade within tiers but to maintain price discrimination among tiers).

negotiations that proved unsuccessful during the TRIPS Agreement negotiations and led to Article 6. This brings us full circle to the failure in Cancun to address the international intellectual property regime in regard to the developing international climate change treaty regime.[322]

Unlike the past failure to reach international consensus over exhaustion principles, however, the current panoply of national laws imposing expansive international exhaustion criteria that are not regionally limited may induce greater willingness to reach a treaty-based compromise, particularly in regard to climate change technologies. Thus, a regional exhaustion regime could potentially emerge either in ongoing international intellectual property treaty negotiations or in the context of ongoing climate change treaty negotiations. If such an exhaustion treaty were limited to climate change technologies, however, the heterogeneity of the climate change technologies and the differences of the innovation incentives and market structures for their development and deployment would require careful attention to definitions of what would be included and how to structure the appropriate regions. These definitions and regions also could vary with the particular technologies and market structures involved. Given the complexities of such a negotiation, continued reliance on domestic law approaches is more likely to continue, even if that result is not to be preferred.

CONCLUSION

The world in Cancun has chosen to rely on the existing international patent system without further regulating it through international treaties to generate the needed climate change adaptation and mitigation technologies. The tensions that such reliance will cause have already been demonstrated during the course of the international climate change negotiations within the UNFCCC. These tensions will continue to be played out at the national level through domestic patent policies, which in turn will likely generate international disputes and could lead to further international regulation of the patent system. Given the magnitude of the climate problems to be addressed, continuous supervision will be needed to determine whether supplemental international approaches should be adopted to further stimulate the innovation and technology transfer pipelines. In particular, additional public funding may be needed for research, development, and dissemination and commons approaches to sharing research and transferring technology may need to be compelled. Finally, unless and until internal agreements develop that further regulate the international patent system or such alternative approaches develop, we will continue to witness national patent and climate change policies develop as laboratories of democracy,[323] and should expect the relationship of the patent system to climate change to remain highly controversial in a wide variety of international negotiating fora.

---

[322] *See supra* notes __-__ and accompanying text.

[323] See New State Ice Co. v. Liebmann, 285 U.S. 262, 311 (1932) (Brandeis, J., dissenting). *Cf.* Joshua D. Sarnoff, The Continuing Imperative (But Only from a National Perspective) for Federal Environmental Protection, 7 DUKE ENVT'L. L. & POL'Y F. 225, 259-61 (1997) (discussing experimentation rationales for federalism, comparative willingness to experiment, and evaluation of success according to decentralized or centralized normative criteria).