



Intellectual Property Institute

**The Economics of Intellectual Property Rights
and Climate Change**

Three New Studies Provide a More Scientific Basis to the Debate

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Executive Summary

The development, deployment and dissemination of low-carbon and other environmental technologies is critical to the global response to climate change. Access to technology is also important to help developing countries reduce their carbon emissions and adapt to the possible effects of climate change. While many environmental technologies are not patented or are long off patent, others are subject to patents and other Intellectual Property Rights (IPRs). The role such rights play with respect to technology transfer has become a topic of heated debate.

Certain developing countries – particularly emerging economies – have claimed that IPRs are a barrier that prevents them from accessing critical technologies for greenhouse gas reduction and climate change adaptation. Others – particularly industrialized countries and the business community – consider IPRs essential to encourage innovation, provide necessary economic justifications for investment, and enable broad technology transfer and dissemination and, thus, to achieve climate change goals. With some exceptions¹, however, the policy debate on this issue to date has lacked a rigorous economic and analytical basis. As a result, there has been little exploration of the character of economics research on this question and whether a consensus view about the relationship between IPRs and innovation, technology transfer and financing exists.

Three new research papers by Daniel K. N Johnson and Kristina Lybecker of University Colorado College fill the gap. With their exhaustive review of the economic literature on environmental innovation, technology dissemination, and financing, Johnson and Lybecker move beyond advocacy, bullet points and sound bites, into a more objective and scientifically-supported discussion of the role IPRs actually play.² The papers provide a comprehensive review of the current body of economics research and a wealth of information on various aspects of the debate and show that a broad consensus among economists on the role that IPRs play in the low-carbon technology space is forming.

Key Findings

- The development, deployment and dissemination of low-carbon and more energy-efficient technology is critical to achieve global climate change goals. While governments can, and should, play a substantial role, engaging private sector investment is key.
- The Johnson and Lybecker papers fill an important gap in our understanding of the role patents and other IPRs play in the energy-efficient or environmental technology space and, in particular, their role in encouraging innovation and enhancing environmental technology transfer.

¹ See, e.g., *Ian Harvey, Intellectual Property Rights: The Catalyst to Deliver Low Carbon Technologies*; Copenhagen Economics, [cite].

² Daniel K.N. Johnson, Kristina M. Lybecker, “Innovating for an Uncertain Market: A Literature Review of the Constraints on Environmental Innovation”, Colorado College Working Paper 2009-06, July 2009; Daniel K. Johnson, Kristina M. Lybecker, “Challenges to Technology Transfer: A Literature Review of the Constraints on Environmental Technology Dissemination”, Colorado College Working Paper 2009-07, July 2009; and Daniel K. Johnson, Kristina M. Lybecker, “Financing Environmental Improvements: A Literature Review of the Constraints on Financing Environmental Innovation”, Colorado College Working Paper 2009-08, July 2009.

Recommendations

- Policymakers would be well-advised to recognize the substantial uncertainties involved in the development, commercialization and deployment of low-carbon and other environmental technologies: uncertainty about the end-product of research and development efforts, the reception by the market, and the possibility to make a commercial return on innovation while competitors try to produce and emulate similar results.
- IPRs play a critical role in overcoming such uncertainties and climate policymakers and negotiators should approach any proposals for their weakening with extreme caution.
- While comparisons to pharmaceuticals (the “Essential Medicines” debate) are widespread, there are substantial differences between the two situations and very few, if any, relevant parallels. Negotiators, consequently, should avoid “Essential Medicines” rhetoric and approach the issue of environmental technology as separate and de novo and should utilize the current and evolving body of rigorous economics research that specifically addresses climate change / IP issues before any conclusions are drawn.
- The research review by Johnson and Lybecker shows that there exists no definitive research describing how compulsory licences might directly and derivatively affect climate change-related innovation. Limiting the patentability of environmental technologies, providing for their compulsory licensing, or allowing IP-related flexibilities might jeopardize essential climate change-related innovation, and may also limit the eventual uptake and deployment of clean and more energy-efficient technologies, including in the developing world. What is, therefore, evident is that the lack of a clear and full understanding of the potential impacts of alternative IPR approaches creates a shroud of uncertainty which in turn elevates the risk of policy failure. Policy making should be based upon solid research of similar character to the research used in the Johnson and Lybecker literature reviews, should conform to a high standard of methodological rigor, and otherwise comport with the principles of good research as well as consider all stakeholder interests. In light of current uncertainties, alternatives to existing IPR policy can only be approached with extreme caution.

The Critical Role of Climate Change Technology and Innovation

The development, deployment and dissemination of low-carbon, more energy-efficient technologies is critical to global climate change goals. Accelerated and substantial clean technology innovation is critical to an effective global response to climate change.³ Technology transfer, broadly defined as the deployment and diffusion of more energy-efficient, lower carbon

³ See, e.g., Intergovernmental Panel on Climate Change, IPCC Special Report, ‘Methodological and Technological Issues in Technology Transfer’ (2000) (“Achieving the ultimate objective of the UNFCCC, as formulated in Article 2, will require technological innovation and the rapid and widespread transfer and implementation of technologies, including know-how for mitigation of greenhouse gas (GHG) emissions.”). See also Pew Center on Global Climate Change, Innovative Solutions to Global Climate Change, In Brief 7 (“Technological change will be instrumental in reducing costs, widening applicability, and improving reliability in efforts to reduce emissions of CO₂ and non-CO₂ gases alike.”)

technology around the world, is key to achieving climate change goals: to do so, however, requires substantial financing, real investment in effective enabling environments (infrastructure, regulatory policies, legal safeguards), and capacity building and training. Required technology investments are already estimated to be as high as \$550 billion annually, or \$45 trillion between now and 2050⁴, and may have to increase by between 100 and 1000 percent (2 to 10 times) if global climate change goals are to be met.⁵

Private sector corporations are key as are equity funds which collectively constitute the largest source of finance for environmental innovation and deployment. Today, two-thirds of innovation is financed by private companies and while government-funded research will be important, enhancing private sector involvement and the further development of break-through solutions from basic knowledge to actual, commercially implementable and broadly usable technology solutions will be essential. For the developing nations, access to equity-class financing will be essential as donor nations are not likely to be able to provide the level of funding required. IPRs will be critical to establishing the normative market structures needed to attract equity-based financing alongside commercial foreign direct investment.

While many environmental technologies are not patented or are long off-patent, others are subject to patents and other IPRs. Some, including negotiators from several major emerging economies and NGOs, have claimed that where IPRs exist, they are a barrier to technology transfer. Indeed, parallels have been suggested to the situation faced by low-income developing countries with respect to certain essential medicines (e.g., HIV/AIDS drugs) where, in some instances, monopoly patent rights may allow pharmaceutical companies to charge excessive prices for their drugs making them unaffordable for the poorest, low-income developing countries. Others, however, point to the important contribution of patents and other IPRs. They encourage innovation, provide for a regulated process of allowing access to technical information in exchange for a fixed period of exclusive use of a technology, and effective IP protection gives companies the assurances they need to provide their technologies and know-how to commercial partners in licensing deals, joint ventures, Foreign Direct Investment transactions, and many other forms of commercial cooperation.

The Johnson and Lybecker Studies: A Scientific Approach

The debate on the role of patents and other IPRs in the climate change technology space has taken on increased urgency with negotiations for a new international climate change treaty entering their final stages. While there is plenty of anecdote and assertion, a more scientific approach has so far been lacking.

The Johnson and Lybecker studies fill the gap, providing a solid, well-researched overview of the body of academic literature that exists on the role of IPRs in driving innovation and encouraging and enabling technology trade and investment in the environmental and low-carbon technology field.

⁴ World Economic Forum, 'Green Investing: Towards a Clean Energy Infrastructure', January 29, 2009; International Energy Agency (IEA), Energy Technology Perspectives 2008, at: <http://www.iea.org/Textbase/npsum/ETP2008SUM.pdf>, p. 3.

⁵ IEA, "2008 Energy Technology Perspectives", cited in EU Commission Communication of January 28, 2009, Background Document, part 2, p. 76.

The Johnson and Lybecker studies were undertaken under strict terms of reference that ensured that the body of work studied, and the subsequent analysis gave rise to intelligence and insight which carries significant authority and would thus be of greatest use to a broad audience of researchers and policymakers. The methodology included taking account of the relationship between the project funders and researchers and it established a firewall which we believe has minimized the chance of bias or undue influence. The authors also established strict criteria with respect to the academic rigor and integrity of the research to be included, taking into account, for example, the depth of citations provided, explanation of the original research methodology employed, and whether the papers were peer-reviewed. This process ensured that the final body of work studied included only well-found research of a high quality and integrity. Finally, in an effort to assist global policy-makers, industry, the media, the public, and to further ensure the independent, peer-reviewed nature of their study, the researchers asked independent reviewers to review the methodology and resulting analysis.

Intellectual Property Rights, the Market and Environmental Innovation

In their first study “Innovating for an Uncertain Market: A Literature Review of the Constraints of Environmental Innovation”, Johnson and Lybecker summarize the state of academic knowledge surrounding the economics of environmental innovation. They enumerate and describe the obstacles and constraints to eco-innovation, as well as factors that can help encourage the required innovation and technology development, including the potential role of IP.

Johnson and Lybecker’s review of the innovation literature leads to several clear conclusions. Principally, they find that there is considerable agreement among economists that IPRs and other market-based tools are critical to overcome the substantial uncertainty involved in the process of investment in environmental innovation. Indeed, say Johnson and Lybecker “[t]here is near universal agreement among economists that strong intellectual property rights are an essential prerequisite to the development of environmental technologies.”⁶

Market-based reviews, they say, show similar results. Most firms indicate that IP Rights are essential to the profitability of their commercial research. Without it, they simply would not commit R&D funding to the market in question. “Innovation”, say Johnson and Lybecker accordingly, “is the response of market-based firms to profit potential and other market-based incentives”.⁷ An effective (i.e., commercial) cost-benefit pay-off is essential.

In some sense, say the authors, “[IPRs] present a double-edged sword: without some guarantee of repayment for the risk and financial sacrifice of the research process, little innovation will occur, but too great an exclusion right may hamper follow-on innovation or may extract inappropriately large monopoly rents from the consumer.” [p.10] Notably, however, say Johnson and Lybecker, the effects of IP rights have been found to vary across industries and innovations. Citing a study by Levin et al (1987), they note that “[while] patents were important, secrecy, lead times, and learning curve advantages were all considered more effective.” The same study also confirmed substantial “inter-industry variation in the evaluation of different appropriability

⁶ Johnson and Lybecker, *Innovating for an Uncertain Market*, p. 3.

⁷ Id., p. 16.

mechanisms”, suggesting “that the impact of policy changes should be assessed at the industry level.” Comparing one industry to another is not helpful: tailored studies and findings are critical.

Intellectual Property Rights, the Market and Environmental Technology Transfer

Beyond innovation *per se*, Johnson and Lybecker also look at the question of technology transfer. Following a brief exploration of relevant legal and regulatory regimes, their paper on “Challenges to Technology Transfer” examines diffusion mechanisms, market factors, social characteristics and political elements that facilitate and complicate dissemination. Many of the challenges to innovation and the dissemination of technology in general, say the authors, are found in the field of eco-innovation as well. The three principal problems are asymmetric information, market power, and externalities. In addition, uncertainty regarding the qualities of the innovation as well as future prices of inputs may complicate technology adoption.

Much of this follows clear commercial logic. The rate of technology diffusion, note Johnson and Lybecker, is dependent on the cost-effectiveness of the new technology. Thus, the firms with the greatest potential profits associated with the innovation will be the first adopters. In addition, new technologies are often capital intensive and associated with size and scale economies, and may require access to substantial amounts of investment capital. Financing and effective commercial mechanisms are key.

Strategies to enhance technology transfer are numerous, and the Johnson and Lybecker studies identify many of them. Liberal trade policies, building human capital and expanding national innovation systems are critical.⁸ One study cited (Sachs 2003) finds that:

“[T]he most effective strategy ... has been the integration of the national economy into world production. Countries that have been able to attract foreign direct investment in export-led sectors have been the most successful in achieving rapid technological upgrading.”⁹

The role of education, telecommunications, R&D subsidies, and the local and region-specific nature of technology uptake and innovation policies are also examined.¹⁰

Are Intellectual Property Rights a Barrier to Effective Climate Change Solutions?

Throughout their studies, Johnson and Lybecker explore the claim that IPRs operate as a barrier to technology transfer. While citing some studies that suggest IPRs may be problematic, they find that there is in fact no evidence to that effect and note that several studies demonstrate the exact opposite.

⁸ Johnson and Lybecker, *Challenges to Technology Transfer*, pp. 19-20, citing Hoekman, Maskus, Saggi (2004).

⁹ Sachs. Cited at Johnson and Lybecker, *Challenges to Technology Transfer*, p. 21.

¹⁰ Johnson and Lybecker, *Challenges to Technology Transfer*, e.g., pp. 19, 22-23, 16-18.

Notably, Johnson and Lybecker find that economic studies generally conclude that trade in patented products with large and middle-income countries is enhanced by stronger levels of patent protection. Complementary factors such as infrastructure enhancements, more effective government, the creation and further development of knowledge institutions, access to finance, human skills and research networks are identified as important factors as well. Together, such elements can create the enabling environments required to enhance trade in, and the local uptake and deployment of energy-efficient, low-carbon and other environmental technologies and solutions.

Hutchinson (2006) finds that IP protection facilitates trade flows of patented goods into large and middle-income nations. Similarly, Park and Lippoldt (2008) empirically analyze the impact of strengthened IPRs in the developing world and find that technology transfer is enhanced by stronger levels of patent protection. In that context, Johnson and Lybecker review the controversies surrounding mechanisms such as compulsory licensing, provided certain conditions and procedures are met (which they note is allowed under TRIPs). Mandel (2005), for example, argues strongly against it, suggesting that it is only of potential help in industries where innovators are not licensing their innovations enough. He further argues that compulsory licensing will reduce the incentive to innovate, whereas innovation is precisely what is required to achieve climate change goals. Hutchinson (2006) finds some arguments in favor of compulsory licensing but concludes that in light of the limited role that patented technology often plays in the overall technology solution, “the mere ability to use the patent may be insufficient to make the technology workable.” (p.12)

Research is more limited with respect to low-income developing countries. While Hutchinson (2006) suggests stronger IP protection may have no impact on trade flows to poor countries, a study by Copenhagen Economics provides a more careful conclusion, noting that there is no evidence in favor of extending TRIPS flexibilities such as those provided for in the pharmaceuticals context to environmental technologies.¹¹ Copenhagen Economics cite, in particular, the number of substitute technologies available, many of which are not protected by IPRs, and the fact that a variety of alternative technologies are available to achieve the same carbon emission reduction objectives. Compulsory licensing, they conclude, would likely serve as a disincentive to further investment, and it is difficult to argue that IP is a barrier to the transfer of technologies to low-income developing countries when, in most them, patents are virtually non-existent.¹²

¹¹ Johnson and Lybecker, *Challenges to Technology Transfer*, pp. 12, 21.

¹² See Johnson and Lybecker, *Innovating for an Uncertain Market*, p. 10.

Environmental Technology and the “Essential Medicines” Debate

Some negotiators and NGOs have alluded to possible parallels between the environmental technology space and the pharmaceutical sector “Essential Medicines” debate. Johnson and Lybecker find that there is no evidence to this effect.

It is important, they say, to draw a distinction between the roles that patents play in the two sectors (p.13). “While the underlying principle is the same (to accord a limited degree of market power, limited by both time and the entrance of competitors, in return for the research and creative process as well as the public sharing of information sufficient to replicate the innovation)”, there are important differences. “Barton (2007) summarizes a key difference particularly well”, say Johnson and Lybecker. His study found that in the case of eco-innovation, most fundamental technologies have long ago been absorbed into popular technical knowledge, and have often been off-patent for decades. Thus, current patents primarily protect amendments or improvements, and competition among alternative models which serve the same general purpose is widespread. By contrast, he found, pharmaceutical compounds are usually the result of completely new biochemical research facing much higher research costs to recover and fewer short-run competitors on the IP-protected market place.

In sum, say Johnson and Lybecker, “while patents serve to encourage innovators in both sectors, it would be extremely simplistic (and probably dangerously incorrect) to make an argument about eco-innovation on the basis of conclusions made for pharmaceuticals.”

Conclusions and Recommendations

The Johnson and Lybecker studies provide an important contribution to the policy and scientific debate about the optimal policy response for the further development, deployment and transfer of low-carbon, energy-efficient technologies; a key issue in the ongoing international climate change negotiations. While further research is still needed, the basic lessons are clear. Economists generally consider IPRs and other market-based mechanisms to play a positive role in the development, diffusion and deployment of environmental technology, and an essential contributor to global climate change policies. Demands for compulsory licensing and other non-market measures must be approached with caution.

One study cited shows just how well the existing system is actually working, contradicting any notion that IPRs are inhibiting the transfer and diffusion of low-carbon and energy-efficient technologies. The European Commission-funded Copenhagen Economics study that we have cited above shows that between 1998 and 2008 the share of environmental technology patents locally owned by investors in emerging economies increased about five times faster than the overall global patent count. To put it differently, China, India, Brazil and other emerging economies are rapidly increasing their share of innovative clean technology solutions. These countries, indeed, are already major players in the field and have patented technology internationally:

“Globally, some 215,000 patent applications were filed worldwide over the period 1998-2008, including some 22,000 in developing countries – out of which about 7,400 were actually owned by developing country residents. When the last four years of the period are compared to the first four years, the global patent count increased by 120%, but by nearly 550% in developing countries. Solar energy and fuel cell patents account for 80% of the count and for most of the growth as well, followed by wind energy as a distant third.” (Copenhagen, 2009)

The success of companies such as China’s Suntech, India’s Tata Wind, and Brazil’s biofuel sector is, of course, a case in point.

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