How Open Source Development Can Resolve the North-South Intellectual Property Conflict in UNFCCC Negotiations: A Bipartisan Technology Transfer Pathway

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Introduction

The current intellectual property regime (IPR) for climate-related environmentally sound technologies (EST) under the World Trade Organization (WTO) administered Trade Related Aspects of Intellectual Property Rights (TRIPs) Agreement and United Nations Framework Convention on Climate Change (UNFCCC) stimulates vertical EST transfer and mitigation technologies under a flexible mechanism for Annex-I countries to meet commitments while inhibiting more sustainable horizontal EST transfer and adaptation technologies for the G77+China. IPR acts both as a driver, in the mitigation of risk for firms, and barrier, in the creation of high transaction costs, to EST transfer in different sectors and environments. The current IPR must be amended to provide full support for a complete portfolio of technology transfer. The G77+China proposals to provide compulsory licensing of EST will likely never be considered an acceptable alternative to the current IPR by developed Annex-I industrialized countries like the US and EU. Instead, IPR should be strengthened in all countries to take advantage of the benefits that IPR currently provides and G77+China negotiating block demands for a Technology Development and Transfer Board (TDTB) and a Multilateral Technology Acquisition Fund (MTAF) should be acknowledged and used to inform the creation of a bipartisan EST transfer proposal. Open source licensing of intellectual property offers an innovative new policy intervention to ameliorate high transaction costs from patent gridlock without breaching core firm competences with compulsory licensing, provides developing countries low-cost EST, and offers the opportunity to create a more collaborative open source international research and development environment for EST. A bipartisan open EST transfer proposal could therefore recommend the creation of mechanisms to promote the open source development, licensing and commercialization of EST. This paper explores the aforementioned argument and then provides a sketch of an “Open Development Fund” for open source EST transfer.

Background on Technology Oriented Agreements under the UNFCCC

In June 1992 the leaders of the world's nations met at the United Nations Conference on Environment and Development (UNCED), informally referred to as the Earth Summit, and drafted the United Nations Framework Convention on Climate Change (UNFCCC). The international treaty came into force in 1994 and by October 2009 the framework had 192 parties. The main objective of the UNFCCC its Parties as stated in Article 2 is "to achieve… stabilization of greenhouse gas (GHG) concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." This stabilization requires a large mobilization of resources to generate innovation and utilize technologies that not only mitigate greenhouse gas emissions but also aid the adaptation of human society to a changing climate system.

Article 4.5 of the United Nations Framework Convention on Climate Change (UNFCCC) goes further and states that developed Annex I and OECD+EU Annex II Parties

"shall take all practicable steps to promote, facilitate and finance, as appropriate, the transfer of, or access to, environmentally sound technologies [EST] 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."

Technology transfer instruments are characterized by the provision of both low-carbon technologies for socio-economic development and funding to implement them. They are therefore useful instruments for both reducing environmental impact and increasing developing country stake in cooperative climate agreements. The UNFCCC group that deals with EST transfer in particular is the Expert Group on Technology Transfer (EGTT) which provides policy recommendations on technology transfer to the Subsidiary Body for Scientific and Technological Advice (SBSTA) which is one of the instruments created to support the work of the Congress of Parties (COP), the central body of the UNFCCC. This specific technology oriented agreement within the UNFCCC is significant because knowledge and technology are strong drivers of national competitive advantage in the economy and military (Siddiqi, 1990). Cooperation in technology development and diffusion marks a significant departure from the national competitive approach. Cooperative technology transfer began in the latter half of the twentieth century with increasing power of multilateral organizations, such as the UN, and transnational corporations. In the context of sustainable development EST transfer offers an opportunity to utilize low-carbon technologies to provide for environmentally responsible economic growth for both rapidly developing countries and developed countries. (Metz et al., 2000)

Ongoing debate concerning technology transfer in Article 4.5 of the UNFCCC led the SBSTA to request a special report of the Intergovernmental Panel on Climate Change (IPCC) Working Group III in 2000 entitled "Methodological and Technological Issues in Technology Transfer." The EGTT is instructed to use this report to provide recommendations to the SBSTA. This report defines technology transfer as

> "a broad set of processes covering the flows of know-how, experience and equipment for mitigating and adapting to climate change… it compromises the process of learning to understand, utilize and replicate the technology, including the capacity to choose it and adapt it to local conditions and integrate it with indigenous technologies."

It is important to regard technology as not only the physical hardware but also the soft-technologies of human capacity, knowledge and know-how which are needed to successfully maintain and operate the hardware. (Metz et al., 2000)

Wilkins (2002) explains that there are two forms of technology transfer: vertical and horizontal transfer. Vertical transfer preserves soft-technology capacity within the, often foreign, firm by locating satellite factories or firms in a target locality whereas horizontal transfer is a long-term process of building local soft-technology capacity as well as implementing hardware through training and financial development. Vertical transfer preserves external ownership and lowers the competitive risk in core competence control for a firm from sharing soft-technology capacity with locals. Wilkins asserts that horizontal transfer leads to a more "sustainable situation" because the embedded localized soft-technology competences maintain and expand the new technologies. The IPCC definition of technology transfer more closely resembles Wilkin's definition of horizontal technology transfer because it emphasizes the need for local agents to choose and adapt technologies to local needs while building local capacity to the degree that it can be replicated. Policy interventions to promote technology transfer should focus on alternatives to the most prevalent pathway for technology transfer which is currently "vertical" private sector support in the form of foreign direct investment (FDI), commercial lending, and equity investment for GHG mitigation projects through the flexible mechanism under the Kyoto Protocol (Metz, 2000). Fundamentally, vertical transfer preserves core, developed nation-firm complex, control over competitive advantages whereas horizontal transfer spreads competences across the peripheral, developing nation-firm complex, reducing core-complex competitive advantage. The current IPR for EST under the WTO administered TRIPs Agreement and UNFCCC stimulates vertical EST transfer and mitigation technologies as a flexible mechanism for developed countries but in doing so hinders the development of horizontal transfer and endogenous capacity development. A reassessment of how IPR and EST transfer interact is therefore needed to provide for more sustainable absorption of EST in developing nations.

The IPCC Model of Technology Transfer

The 2000 IPCC Special Report on Technology Transfer outlines a useful model of technology transfer that considers stakeholders, pathways, stages and barriers. According to this model there are many pathways through which stakeholders, such as owners, suppliers, buyers, consumers, firms, financiers, governments, donors and NGOs, interact to transfer technologies. Common technology transfer pathways include government assistance programs, direct purchases, licensing, foreign direct investment, joint ventures, cooperative research arrangements and co-production agreements, education and training, and government direct investment. Each one of these pathways is environmentally and technologically situated and varies accordingly. The report defines five basic stages or combination of actions that lead to the deployment of technologies to respond to demand within each pathway. The five stages in order are assessment of needs, technology, and conditions of transfer; agreement between stakeholders; implementation; evaluation and adjustment to local conditions; and local replication of the technology. (Metz, 2000)

Barriers to Technology Transfer

Barriers to successful EST transfer may occur at each stage in the technology transfer pathway and are environmentally and technologically situated in local and sectoral contexts. It is therefore necessary to identify these barriers and develop, implement and review policy interventions to address public and market failures. Some general barriers include lack of financing, socio-cultural preferences, high transaction costs, local cost effectiveness, local infrastructure and knowledge capacity, corruption, lack of confidence in new technologies, and lack of political, institutional and legislative capacity. A fundamental barrier is often that target ESTs are not designed to fit local context and demand. Government policy interventions to reduce barriers and improve technology transfer pathways legitimized through the UNFCCC take three approaches: building human, organizational, and information assessment and monitoring capacity; creating an enabling environment; and creating and facilitating technology transfer instruments.

Historically there are significant differences between what developed and developing countries consider being key barriers to EST transfer and this strongly affects the policy outcomes of international climate negotiations. As the next section details, developed countries tend to focus on weak intellectual property regimes in developing countries as being a key driver of risk and reluctance for technology licensing in developing countries by EST patent owners. Developing countries, on the other side, believe that lack of adequate funding and cooperation from developed countries has inhibited the creation and absorption of climate mitigation and adaptation technology. Climate negotiations are dominated by developed industrial countries and large developing countries and therefore the urgent need for adaptation technology innovation and absorption for small low developing countries is pushed out of the debate. (Metz, 2000; Wilkins, 2002)

The History of "North-South" Divide over Intellectual Property Rights in Technology Oriented Agreements

The current impasse in climate negotiations between developing and developed nations over whether intellectual property regimes are a barrier or driver of technology transfer was brought to worldwide attention at the 2007 COP13 in Bali, Indonesia. While leaders from both developed and developing countries agreed, pursuant to Article 4.7 of the UNFCCC, that the development and transfer of technologies from developed to developing nations is necessary to address climate change there were serious disagreements over the role of intellectual property as a driver of this transfer. Differences in interpretation and perspective centered on Decision 3/CP.13 which recommends that all Parties, "avoid trade and intellectual property rights policies, or lack thereof, restricting transfer of technology." Cuba, India, Tanzania, China and Indonesia among others adopted an interpretation of Decision 3 that intellectual property regimes are a barrier to access necessary EST (ICTSD, 2008). The United States and Australia, on the other side, maintained that weak intellectual property regimes in major developing countries are a main barrier to the export of "greenhouse gas intensity reducing technologies" as identified in a report by the Office of U.S. Trade Representative (USTR, 2006). Neither side is incorrect because IPR acts both as a driver, in the mitigation of risk for firms, and barrier, in the creation of high transaction costs, to EST transfer in different sectors and environments.

This impasse was the result of many years of poor cooperation between developing nations such as China and India with developed nations such as the US and EU. Early on, during the first meetings of the SBSTA, developing nations demanded the acceleration of technology transfer without providing information about their technology needs; due in large part to a lack of stage one technology assessment funding, and developed nations, noting the role that the private sector plays and downplaying the role of government policy while carrying out their responsibilities through vertical technology transfer through market-based joint implementation measures, focused their attention and resources on mitigation not adaptation. At the 1998 COP4 Annex I countries, mainly the US, Australia, Japan and Canada targeted the Clean Development Mechanism (CDM) of the Kyoto Protocol, which was adopted in 1997, as the main instrument for technology transfer. From their perspective non-Annex I developing nations needed to create stronger intellectual property regimes so that firms operating under the CDM could secure their technologies against unregulated use when licensing them in the country. (CIEL, 2008)

The EGTT was established at the COP6 in 2000 and was intended to provide support for technology transfer. However, the group was largely ineffective because the group was comprised of administrators with little experience in intellectual property law or technology transfer. At the COP12 in 2006 the G77+China submitted a proposal to replace the EGTT with a Technology Development and Transfer Board (TDTB) and a Multilateral Technology Acquisition Fund (MTAF) to license intellectual property in conjunction with the vertical transfer efforts of the CDM. The G77+China negotiating block continues to argue that legal and regulatory arrangements including the compulsory licensing of patented ESTs is essential for EST transfer to developing countries. In a compulsory license a government forces a firm to license intellectual property to an entity and often includes remuneration through arbitration. It has historically only been allowed under emergency situations and has been used to provide generic drugs. This proposal was again opposed by the reactionary Annex I parties: the US, EU, Japan and Canada who preferred to maintain the ineffective EGTT and rejected outright the idea of compulsory licenses fearing that it would reduce incentives for foreign direct investment and other forms of core developed country influence in developing nations under vertical EST transfer. (ICTSD, 2008; Euractiv, 2009)

Do IPRs Constitute a Barrier to EST Transfer?

Srinivas (2009) argues that IPRs constitute a barrier to EST transfer to developing countries. Srinivas reviews the solar energy, wind energy, bio-fuels, climate-resistant crops, and clean-coal sectors and finds that technology transfer under intellectual property regimes is often only successful when developing country firms are able to acquire EST patents through the acquisition of foreign firms with already existing EST competencies. Developing nations are then able to build their endogenous knowledge capacity. This transfer pathway has been utilized in the solar and wind energy sectors in India and China but is unlikely to be successful in adaptation efforts or in mitigation efforts in small developing countries. In the bio-fuels and crops sectors where innovation is created from the synthesis of knowledge the increase of patents on genetically modified organisms and manufacturing processes (knowledge) enforced by the WTO administered Agreement on TRIPs creates a patent gridlock. Gridlock occurs when knowledge is owned under monopoly control of knowledge enforced by patent law which fragments the necessary knowledge to be synthesized in the new innovation between many owners resulting in often insurmountable barriers to licensing and commercialization of innovations.

One tragic example of gridlock, or the "tragedy of the anticommons," detailed by Michael Heller in *The Gridlock Economy* (2008) is an incident where a large pharmaceutical company discovered a potential cure for Alzheimer's disease but was unable to test the drug because biotech competitors were able to use their knowledge competences, in the form of patents, to block the development by refusing to license their patents on neurological pathways. This extends to any knowledge-intensive sector, like EST, where many different patents must be assembled and licensed to commercialize new innovation. Both the risk involved in licensing firm competences in developing nations and the burden of assembling many different patents to monetize innovation constitute invisible transaction costs and significant barriers for EST transfer. In general, empirical research has shown that intellectual property regimes actually reduce knowledge diffusion. *Do Formal Intellectual Property Rights Hinder the Free Flow of Scientific Knowledge? An Empirical Test of the Anti-Commons Hypothesis* by Murray and Stern (2005) showed the rate of peer-reviewed paper publishing to patents is indirectly correlated for identified paper-patent pairs. Both theory and empirical research on the transaction costs of intellectual property regimes supports the developing countries claims that IPR often constitutes a barrier to EST transfer. Unfortunately, this work has been ignored by developed countries and the UNFCCC administration. (ICTSD, 2008).

Open Source Development

An open source development, licensing and financing/commercialization regime for EST would complement the current intellectual property regime in force by the TRIPs Agreement and benefit from its continued spread and ability to reduce risk in licensing proprietary EST while addressing the need for an IPR that overcomes the transaction costs of patent gridlock. Open source licensing, development and cooperative mesocredit financing mechanisms linked to open source EST development would provide an enabling environment for EST transfer and foster human capacity and firm creation respectively. Open source development is an integrated system and requires all three aspects to operate successfully.

Open Source Software Licensing

Open source licensing overcomes proprietary patent gridlock because EST developed through an open source framework is essentially public domain and can be used freely by anyone. This freedom is enforced under IPR through a "copyleft" logic pioneered by Richard Stallman in 1996 called the "Free Software Definition." This definition has four points that define whether software is free by whether a recipient (i.e. target developing country or researcher etc.) has the freedom to: (1) use the software, for any purpose, (2) study how the software works, and adapt it to their needs, (3) redistribute copies so they may help their neighbor, (4) improve the software, and release their improvements to the public, so that the whole community benefits (FSF, 2009). This definition has been used to draft the widely used GNU Public License (GPL). The GPL and open source licensing in general is different than IP released in the public domain because it is viral and "infects" any subsidiary work. This ensures that all following research and development work can be used freely and that R&D pathways don't become proprietary "dead-ends" for the R&D and user communities that has already invested significant capital in the product when support is dropped for the product or the product becomes black-boxed and inaccessible to useful modification. Both proprietary licensing and patents and open source licensing have different research and development pathways for their products and business models. Open source research and development pathways are characterized by a networked collaborative development model that brings together contributions from two to thousands of researchers and developers, professional and amateur, to create a product that is being continually maintained and improved. Furthermore, open source development is provided as a community service for free to anyone who might use their work without the need for incentives from proprietary knowledge monopolies. Wikipedia, an open source collaborative product of the Wikimedia Foundation, is a good example of a product of the networked collaborative development model. Wikipedia is now the fourth most popular website on the internet and is built, maintained and upgraded by hundreds of thousands of individuals.

It should therefore be surprising to many individuals who assert that proprietary ownership of intellectual property is the only incentive for work and innovation that the open source software industry has proven itself to be enormously successful in terms of technology diffusion and absorption which are the ascribed goals of EST transfer. Mozilla's Firefox browser has become ubiquitous on home desktops and Apache web server software being the most widely used server software since 1996 with over 100 million corporate, government and individual users beating Microsoft's second leading software by more than 60 million users (Netcraft, 2009). In all of these cases cooperation in innovation of technologies was more effective than market-based competitive innovation. Open source licensing has proven itself to be useful and successful in the software industry and people across the world are now working to extend this success to other industries. Some, like Wesley M. Cohen, however, are skeptical as to whether open source licensing can apply to industries outside of software (Cohen, 2005). Regardless of skepticism open source licensing is now moving from software to intellectual property in general as people experiment with open hardware development.

Open Source Hardware and Intellectual Property

Many open source projects and developer communities exist to develop electronics hardware. These include the popular Arduino electronics prototyping platform that is also based on open source software (http://www.arduino.cc/) and Sun Microsystem's OpenSPARC T1 multicore processor (http://www.opensparc.net/). Sun Microsystem's continued support of open source software; for example, OpenOffice, the free and compatible alternative to Microsoft Office, and hardware products proves that products can be successfully licensed open source by for-profit corporations. Often, private business, finds that the benefits of an open development community outweigh the costs of not having a proprietary monopoly on the product's intellectual property. Open source initiatives for EST hardware already and is known as the Open Source Ecology Movement (http://openfarmtech.org/). This open research and development movement is "dedicated to collaborative development of tools for replicable, open source, modern off-grid resilient communities." The movement is spearheaded by a research and development facility called the Factor E Farm in US State of Missouri and is supported by donors and collaborators across the world. In 2008 Factor E Farm and supporters released an open source tractor, called LifeTrac, that, if constructed using traditional proprietary industrial technology is projected to have cost $251,000 but was instead manufactured for a cost, including labor, of $30,000 (Factor E Farm, 2009a). In 2009 they released an open sourced compressed earth block press, called the Liberator, for the sustainable construction of low-cost self-built housing at a cost of $5,500 compared to $20,000 for a proprietary press of similar specifications (Factor E Farm, 2009b). All EST developed in the Open Source Ecology Movement are intended to be manufacturing using a small-scale vertically integrated decentralized flexible fabrication facility costing less than $100,000 that would up-cycle local scrap and materials that have been spread across the world from globalization (i.e. steel, copper, plastics, etc). Such a facility is intended to be used to provide an extensive array of EST for a resilient community referred to by the Factor E Farm as the "Global Village Construction Set." Conceivably a modified Technology Development and Transfer Board would facilitate connections between the EST needs of developing nations and an open source networked collaborative EST development community from around the world, much like the Wikimedia Foundation supports thousands of contributors from around the world. Such a development community is inherently horizontally organized and would support sustainable horizontal EST transfer.

Open Source Research and Development Financing

There are several large differences between open source software and hardware development. Mainly, while it may be free, *libre*, to copy software and hardware designs, and it may also be free, *gratis*, to copy software itself, it is not *gratis* to copy hardware itself. The actual copying of hardware requires capital investment whereas copying software requires the shifting of bits and bytes across disks or networks. So far this paper has explained how open source licensing of products requires an active open source development community. This difference between open source software and hardware development necessitates the third necessity of open source development regime for EST, a financing mechanism. Although some for-profit corporations, like Sun Microsystems, invest employee time and company finances into open sourced product development business models like these are not yet proven. A better financing mechanism for R&D would be public-private partnerships to generate a large body of open source EST which private firms can utilize for their role in EST diffusion. Again, an instrument similar to the Multilateral Technology Acquisition Fund supported by the Global Environmental Facility (GEF), which manages the UNFCCC's general financing mechanism, could be used to identify successful open source EST projects and provide R&D funding. In addition to supporting the free diffusion and absorption of necessary EST for mitigation and adaptation through open source development communities such a financing mechanism might shift the proprietary licensing of university research back to what was once a more open environment with broader accessibility. It might be argued that all research funding should be licensed under open source in the interest of rapid diffusion of EST. The question remains, however, whether the open diffusion of EST implies a more rapid absorption of EST as defined by indicators of GHG mitigation and climate adaptation.

The Problem of Open Source Product Commercialization

Many people will still ask the question of how these open sourced products will become commercialized. If no one owns exclusive intellectual property rights to the EST why would anyone risk investment in bringing the product to market? A simple answer to this question is that the products are useful and that there is demand for them. There is a large array of incentives beyond that of assured monopolistic competition over intellectual property. Because there is an open freely growing and evolving market of ideas for product designs and manufacturing processes the primary motive of firms should be market penetration and the utilization of these development community networks. Firms that are able to most effectively tailor open sourced EST to local conditions will be the most successful. As Wilkins (2002) explains, "One of the fundamental barriers which is often faced in transferring technology to developing countries is that the technology being transferred is not appropriate to the local context and demands or is not adapted to the local environment." This is therefore an area in which firms can prove competitive advantages and therefore mitigate risk of investment.

An Integrated Financing Mechanism for Open Source EST Diffusion and Absorption: The Open Development Fund

For the GEF and donor Parties the impact of project funding is of great interest. Ideally, every dollar spent is allocated as effectively as possible. A revolving loan fund in the form of a non-profit endowment, the Open Development Fund (ODF), could function as a financial instrument with which to integrate both open source EST research and development grants and open source EST commercialization in target countries. Such a fund would make equity investments similar to a venture capital fund in firms that utilize open source EST. Equity returns would then be used to maintain the endowment and provide open source EST R&D grants. Alternatively, the fund could make business loan investments similar to a community development bank and returns would be used to maintain the endowment and provide open source EST R&D grants. Both alternatives would likely function similarly to community development microfinance organizations like the Grameen Bank because firm competences would be specific to local markets. Such mesocredit loans or equity investments could see the rapid deployment and absorption of location-specific low-carbon technologies and human capacity across the developing world in a matter of years as investments are made in EST and the small-scale vertically integrated decentralized flexible fabrication facility necessary for full absorption and the final stage of the IPCC model of technology transfer, replication.

Participatory Decision Making and Democracy in the Open Development Fund

Open source R&D communities are networked through the internet and globalization in general. The internet and communications technologies offer great advantages in the provision of digital instruments to improve participation in decision making, thus making decisions made by institutions more legitimate and democratic. Currently, the GEF, while it is an independent organization, is administered by the WTO which is dominated by countries with the largest relative market size such as the EU and the US (Steinberg, 2002). This has been a strong source of contention for developing countries. While the digital divide is a serious issue that needs resolved, decisions on the allocation of R&D grants and endowment investments could be complimented by two online decision support services. One, everyone in the world of voting age (16) would have a vote on grants and endowment investments through an online website. This website would provide all necessary information on the grant and endowment investments. Voters would also be encouraged to provide suggestions on how to improve business models for endowment investments and what their needs were in order to tailor R&D grants. This would provide for another avenue of information in the localization of EST transfer, democratic compliment to decisions made by the Open Development Fund, and a degree of global legitimacy to the operations of the UNFCCC. Two, the behavior of voters as they interact with grant and investment proposals would be statistically analyzed over time to generate a predictive algorithm of the likelihood of success that a proposal might have. This predictive indicator would change over time as attention and interaction with proposals by voters and their social networks was analyzed. This indicator could be a useful aid for policy makers.

Conclusions

This paper has reviewed the interaction between IPR and technology transfer in the context of the UNFCCC and climate change mitigation and adaptation. It has shown that the current TRIPs and UNFCCC regime stimulates vertical EST transfer and mitigation technologies as a flexible mechanism for developed countries while inhibiting more sustainable horizontal EST transfer and adaptation technologies for developing countries. The paper has suggested an integrated open source development model for a complete portfolio of EST transfer in order to address the current North-South impasse over IPR, more rapidly increase the diffusion and absorption of EST in both developing countries and deprived communities in both developed and developing countries in general, and increase the impact of GEF funds. This development model requires the development of open source intellectual property patents by the WTO, the encouragement of networked collaborative open source EST development communities and an integrated financing mechanism to fund EST R&D and provide mesocredit financing for local EST firms to build climate resilient communities.

Further research needs done to assess whether open source based diffusion of EST implied a more rapid local absorption of EST as defined by indicators of GHG mitigation and climate adaptation than conventional IPR. This will require experimental support for existing open source development efforts in the short run. Such support could be provided by organizations like the World Bank which provided experimental support for projects prior to the implementation of the Clean Development Mechanism under the UNFCCC in 2005. Integrated open source development is encouraging theoretically because, like its legal basis, it is viral. Open Source Development promises to make innumerable small on-the-ground improvements in GHG mitigation and climate adaptation tailored to specific community needs across the world by providing open access to environmentally sound technologies.

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