Sharing Potential and the Potential for Sharing: Open Source Licensing as a Legal and Economic Modality for the Dissemination of Renewable Energy Technology

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With only minor deviation, the international community brings together world leaders, diplomats, scholars, corporate enterprises, and non-governmental organizations roughly every five years to address the most pressing threats to humanity and the environment. Not coincidentally, Moore's law, named after the famous Intel engineer Gordon Moore, posits that technological innovations succeed in quadrupling the number of transistors per circuit - and hence technological and computing capacity – roughly every five years. In every half-decade interval beginning with the Stockholm Conference in 1972 and following the last summit in Marrakech in 2003, the international community has sought to utilize technology to reduce the seemingly inexorable gap between human progress and environmental degradation.

As reports emerge forecasting the rapid increase in petroleum prices and as developing parts of the world struggle to secure adequate energy sources for burgeoning economic production, ever-greater attention is being paid to sustainable and renewable forms of energy. Incontrovertible evidence suggests that developing countries are quickly surpassing developed countries in terms of their energy demand for their industrial, residential, and commercial sectors.[1] It is hard to overlook the current and future energy demands of the regions with approximately three-fifths of the world's population. In order to quench the growing energy needs in the developing world without the accompaniment of traditionally violent and disruptive geopolitical influences, it will be necessary to develop and promote sustainable and renewable

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[1] Alex Kirby, *Energy: Meeting Soaring Demand*, **BBC News**, Nov. 9, 2004.

forms of energy.[2] Presently, many such technologies exist, but with only limited application and protected by highly coveted and tightly policed proprietary licenses and exclusive patents.

There are considerable barriers to the development, deployment and marketability of renewable energy largely because patent schemes shield proprietary licenses in regions where capital is most aggregated and profits margins are abundant. Start-up costs continue to deter new entrants from trying their hand at developing efficient renewable energy systems. Proprietary licenses impose steep costs to firms seeking to purchase protected technology for regional deployment. Lastly, legal patent protection provides an artificial and non-competitive monopoly on technology that has widespread applicability and potentially unimaginable economic and environmental value.

Meanwhile, so-called "copy-leftists" in the software industry have spawned a movement to create and freely license software programs and operating systems to programmers who promise to then license for free any innovations or improvements. This movement, coined "open source," is gaining momentum and visibility on account of the widespread use of its non-proprietary operating system Linux and because of the allure of freely disseminated software. The open source theory is now being expanded and applied in varied contexts outside the realm of software. The legal and economic character of software and renewable energy technology are parallel in many ways.

Part I of this paper will discuss various multilateral renewable energy treaties. In particular, this paper will explore the legal and normative support for collaborative transfer of

[2] *See e.g.* Tony Cheng, *China Looks to Renewable Power*, BBC News, Mar. 1, 2005. China's legislature, for instance, has passed a law seeking to increase the use of solar and wind energy to 10% of China's total energy consumption. *Id.* This move is largely a response to rising oil prices and concerns over environmental degradation. *Id.* China may be one of the fastest growing economies in the developing world and it currently relies on coal for most of its power needs, mining roughly 1.8 billion tons in 2004 alone.

renewable energy technology. Part II of this paper will trace a brief history of the open source movement and introduce some basic tenets of its philosophy. This paper will draw from theory on sharing and collaborating as an economic modality.[3] A basic economic and legal analysis of open source will follow. Part III will synthesize the open source philosophy with the practical legal and economic hurdles interposed by existing technology frameworks. Lastly, this paper will argue that non-proprietary licensing of renewable energy technology would promote more regional and national renewable energy economies of scale, effectively divert the use of unsustainable and non-environmentally friendly energy sources, and equitably and efficiently disseminate renewable energy technology to maximize its utility.

Thus, the non-proprietary licensing espoused by the open source developers provides a unique economic and legal modality for development and dissemination of renewable energy technology.

I. Multilateral Framework for Renewable Energy Technology

International law pertaining to renewable energy technology, though highly politicized by interest groups and national political agendas, remains largely a creature of aspirational multilateral declarations. Even as the Kyoto protocol comes into effect with Russia's ultimate decision to ratify the treaty, significant questions remain as to the effectiveness of a treaty that is not inclusive of all the economic superpowers or the worst polluters. Despite politicization and isolation of the global environment as a solitary "issue," multilateral and institutional attempts to address core environmental values have focused on sustainable and renewable energy. Presently, the limited application and availability of renewable energy technology hinders widespread deployment of "environmentally safe" energy. A significant body of institutional declarations

[3] *See generally* Yochai Benkler, *Sharing Nicely: On Shareable Goods and the Emergence of Sharing as a Modality of Economic Production*, 114 **Yale L. J.** 273 (2004).

and international partnerships reveals the emergence of a growing consensus on the need to disseminate renewable energy technology. Although few of the foregoing instruments create binding legal obligations on participating States, the textual references to renewable energy technology dissemination and technology sharing supports the legal recognition of non-proprietary technology licenses as a mechanism to develop, distribute and deploy technology. This part will analyze language in various international institutions' declarations and agendas that provide safe harbors and legal protection for non-proprietary licensing mechanisms for renewable energy technology.

A. Rio Declaration

In June 1992, the United Nations General Assembly convened on the environment and development with the goal of "establishing a new and equitable global partnership through the creation of new levels of cooperation among States, key sectors of societies and people."[4] The General Assembly concluded the conference by issuing the Rio Declaration on Environment and Development (Rio Declaration), which reaffirmed the Stockholm Declaration and sought to promote international environmental and developmental agreements.[5] The resultant Rio Declaration proclaimed a panoply of principles that the drafters may not have expected to immediately become binding international law, but undoubtedly hoped States would pursue through diplomatic and legal avenues. Principle two recognized the sovereignty of States to exploit their own resources under national environmental and developmental policy, but recognized the responsibility of States to ensure that domestic activity does not contribute to transnational environmental degradation.[6]

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[4] *Report of the United Nations Conference on Environment and Development*, U.N. GAOR, 26th Sess., Annex I, U.N. Doc. A/CONF.151 (1992) [hereinafter Rio Declaration].
[5] *Id.*
[6] *See* Rio Declaration, *supra* note 4, at Principle 2.

Principles three through six articulate notions of developmental and generational equity, cooperation towards eradicating poverty and development, and special treatment of developing countries.[7] Principle 7, although non-binding, provides that "States *shall cooperate* in a spirit of global partnership to conserve, protect, and restore the health and integrity of the Earth's ecosystem (emphasis added)," and acknowledges the disparate contributions toward environmental degradation between developed and developing countries.[8] The term "shall cooperate" is more than a term of art; it suggests that States have an affirmative duty to cooperate. Cooperation, although broad in meaning and ill-defined in the Rio Declaration, suggests that States ought to promote inclusive and collaborative means of achieving the common goals outlined in the preamble.

Principle 9 elucidates the cooperation principle by encouraging States to "strengthen endogenous capacity-building for sustainable development," and lists numerous methods, such as: "improving scientific understanding through exchanges of scientific and technological knowledge, and by enhancing the development, adaptation, diffusion and transfer of technologies, including new and innovative technologies."[9] The drafters quite clearly contemplated that substantial barriers to technological development and diffusion existed, and thus they sought to indoctrinate a notion of technology sharing through a new paradigm.

B. United Nations Framework Convention on Climate Change

At the beginning of the new millennium, the Annex I Expert Group on the United Nations Framework Convention on Climate Change (UNFCCC) requested a report on international energy technology and climate change from the Organisation for Economic

[7] *See* Rio Declaration, *supra* note 4, at Principles 3-6.
[8] *See* Rio Declaration, *supra* note 4, at Principle 7.
[9] *See* Rio Declaration, *supra* note 4, at Principle 9.

Cooperation and Development (OECD) and the International Energy Agency (IEA).[10] The OECD and the IEA surveyed numerous international agreements to divine the current international legal landscape relating to international technology transfer and environmental pollution.[11] The two organizations assessed the capacity of various international organizations to deliver financing to green technology initiatives and proposed four basic prescriptions for promoting environmentally friendly technology transfer.[12] The International Energy Technology Collaboration and Climate Change Mitigation (IETCCCM) postulated that "[I]nternational technology cooperation, by sharing information, costs, and efforts, might accelerate and facilitate technical change towards more climate-friendly technologies."[13] Although not binding on the Annex I Expert Group or the UNFCCC, the jointly submitted report provides persuasive support for a technology-sharing paradigm to alleviate climate change. The IETCCCM utilized a narrow

[10] *International Energy Technology Collaboration and Climate Change Mitigation* 1, COM/ENV/EPOC/IEA/SLT (2004) [hereinafter IETCCCM]. The Annex I Expert Group oversees development of analytical papers to provide useful and timely input to the climate change negotiations. *Id at Foreword*. The Annex I Parties to the United Nations Framework Convention on Climate Change (UNFCCC) include: Australia, Austria, Belarus, Belgium, Bulgaria, Canada, Croatia, Czech Republic, Denmark, The European Community, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Monaco, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom of Great Britain and Northern Ireland, and the United States of America. *See* United Nations Framework Convention on Climate Change (with annexes), May 9, 1992, art. 4.1(c), 1771 U.N.T.S. 163 [hereinafter UNFCCC].

[11] *See* IETCCCM, *supra* note 10 at 6.

[12] *See* IETCCCM, *supra* note 10 at 7. The report suggests, first, that it is crucial to further strengthen and "green" international trade and investment. *Id.* Second, it is important to seek new and strengthen existing agreements in ways to "share the 'learning investments' necessary to bring new climate-friendly technologies into the marketplace." *Id.* Third, better coordination between governments with respect to testing methods, consumer information, performance standards and promotional labeling would be helpful. *Id.* Lastly, the report suggests increasing the possibilities of flexible mechanisms in fostering technology transfer to greatly enhance a move from project-based approaches to international emissions trading systems in both industrialized and developing countries. *Id.*

[13] *See* IETCCCM, *supra* note 10 at 6. The report quelled the fears of free-market enthusiasts by suggesting that cooperation between States should not preclude competition between companies and opined that cooperation might catalyze governments to increase their efforts to support basic research and development. *Id.*

definition of technology transfer throughout its report: "technology transfers flowing from Annex II countries to non-Annex I countries."[14]

The IETCCCM addresses the economic characteristics of technology sharing and opined that research and development cooperation magnifies results and helps to more quickly disseminate the resultant technology.[15] Specifically, the report cites reduced research and development costs when States collaborate their energy technology developments because cooperative economic behavior enables result sharing and avoids duplication of efforts and increases the rate of technological innovation.[16]

The IETCCCM applies a comprehensive economic assessment of technology sharing and concludes that because environmentally-friendly technologies are akin to public goods, free markets provide imperfect incentives towards innovation and thus supply is insufficient for the market.[17] The report notes that the enormity of energy technology's start-up costs discourages many countries from developing the technology on their own.[18] For example, the report cites a four-country nuclear fusion initiative that initiated one of the largest international cooperation projects in the technology realm.[19]

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[14] *See* IETCCCM, *supra* note 10 at 8. The report noted, however, that the Intergovernmental Panel on Climate Change (IPCC) broadly 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 amongst different stakeholders such as governments, private sector institutions…The broad and inclusive term "transfer" encompasses diffusion of technologies and technology cooperation across and within countries. It covers technology transfer processes between developed countries, developing countries and countries with economies in transition, amongst developed countries, amongst developing countries and amongst countries with economies in transition.

Id. For purposes of this paper, technology transfer will refer to the definition provided by the IPCC. *Id*

[15] *See* IETCCCM, *supra* note 10 at 10.

[16] *See* IETCCCM, *supra* note 10 at 10.

[17] *See* IETCCCM, *supra* note 10 at 10.

[18] *See* IETCCCM, *supra* note 10 at 10.

[19] *See* IETCCCM, *supra* note 10 at 10. This project was called the International Thermonuclear Experimental Reactor (ITER). *Id.*

While the authors of the IETCCM have their greatest expertise in economic development, they thought it wise to include relevant provisions of the UNFCCC in their report to bolster the international legal credibility of the report's findings and conclusions. The UNFCCC provides in Article 4.1(c) that all parties "shall *promote and cooperate* in the development, application and diffusion, including transfer, of technologies…in all relevant sectors, including the energy, transport, industry, agriculture, forestry and waste management sectors."[20] Further, Article 4.2(e) provides that Annex I parties "shall coordinate as appropriate with other such Parties, relevant economic and administrative instruments developed to achieve the objective of the Convention."[21] Article 4.5 contains language that is remarkably similar to the Rio Declaration, stipulating: "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…."[22] Contrary to the Rio Declaration, which was primarily aspirational, the UNFCCC has many signatory States and creates binding treaty obligations.[23]

The UNFCCC created a Conference of the Parties (COP) to facilitate and implement the goals of the Convention.[24] Notably, the seventh annual COP in Marrakech established an Expert Group on Technology Transfer (EGTT) to effectuate implementation of Article 4.5 of the UNFCCC.[25] The COP agreed on a technology framework including four basic activities, including: technology needs assessments; technology information; enabling environments for

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[20] *See* UNFCCC, *supra* note 10 at art. 4.1(c).
[21] *See* UNFCCC, *supra* note 10 at art. 4.2(e).
[22] *See* UNFCCC, *supra* note 10 at art. 4.5. "In the process, the developed country Parties shall support the development and enhancement of endogenous capacities and technologies of developing country Parties." *Id.*
[23] *See infra* part III(b).
[24] *See* UNFCCC, *supra* note 10 at art. 7. The Kyoto Protocol, among others, is the product of negotiations between and among the Conference of the Parties (COP).
[25] *See* IETCCCM, *supra* note 10 at 19.

technology transfers; and capacity building.[26] An international undertaking organically developed from the UNFCCC, providing services, creating an electronic technology clearinghouse, holding technology workshops, facilitating macroeconomic policy reforms, and creating legal and regulatory frameworks to promote transnational technology transfer.[27]

C. *Agenda 21*

At the Rio Conference in 1992, more than 178 States adopted a comprehensive plan of action to address anthropogenic impacts on the environment.[28] The Rio Conference produced Agenda 21, which was intended to showcase and codify an international consensus on a framework for global cooperation on environmental and developmental issues.[29] The magnitude and far-reaching vision of Agenda 21's scope is apparent from its four broadly entitled sections that relate technology, humanity and the environment.[30]

Agenda 21 acknowledges that international economics is a key component of any strategy to address developmental and environmental issues.[31] Therefore, Agenda 21 targets

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[26] *See* IETCCCM, *supra* note 10 at 19.

[27] *See* IETCCCM, *supra* note 10 at 19-20. Financing for climate change projects is available through the Global Environment Facility, which has provided $1B for such projects and leveraged more than $5B in co-financing. *Id.* at 20. More than half of the Global Environment Facility's financing has gone towards renewable energy projects and more than a quarter has been devoted to energy efficiency projects in forty-seven developing and transitional economies. *Id.* In 2002, the international environmental legal framework again intersected with technological economies of scale when donor nations agreed to replenish the fund by $3B just before the World Summit on Sustainable Development in Johannesburg. *Id.*

[28] *See* UN Department of Economic and Social Affairs, Division for Sustainable Development, *at* http://www.un.org/esa/sustdev/documents/agenda21/index.htm.

[29] *Agenda 21*, UN Department of Economic and Social Affairs, Division for Sustainable Development, Doc. A/CONF.151/26 (Vol. I-III) (Aug. 12, 1992) [hereinafter *Agenda 21*], available *at* http://www.un.org/esa/sustdev/documents/agenda21/english/agenda21toc.htm.

[30] *See Agenda 21*, *supra* note 29 at §§ I-IV. The Sections are entitled as follows: Social and Economic Dimensions; Conservation and Management of Resources for Development; Strengthening the Role of Major Groups; and, Means of Implementation. *Id.* For purposes of this paper, Section IV is the most critical section on because it establishes a framework in which to address anthropological causes of environmental degradation.

[31] *See Agenda 21*, *supra* note 29 at ch. 2. "Economic policies of individual countries and international economic relations both have great relevance to sustainable development. The reactivation and

international trade as the primary vehicle for effectuating an "open, secure, non-discriminatory and predictable multilateral trading system" that "leads to the optimal distribution of global production in accordance with comparative advantage."[32] Chapter 2 discusses the economics of sustainable development in terms of the special and differential status of developing and least developed countries and recognizes the modern day inequities of the international trading system.[33] Chapter 2 sets out a series of objectives that appear to impose aspirational benchmarks, rather than obligations, on national governments, including: promoting an open and equitable multilateral trading system; improving market access for exports of developing countries; improving functioning of commodity markets; and, promoting and supporting both domestic and international policies that align economic growth and environmental protection.[34]

Of primary importance to the realm of energy technology is Agenda 21's chapter on "Transfer of Environmentally Sound Technology, Cooperation and Capacity-Building," which views technology holistically from process to product technologies.[35] In line with a holistic understanding of technology, Chapter 34 addresses total technology systems, including: know-

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acceleration of development requires both a dynamic and a supportive international economic environment and determined policies at the national level. It will be frustrated in the absence of either of these requirements. A supportive external economic environment is crucial." *Id.* at ch. 2.2.

[32] *See Agenda 21, supra* note 29 at ch. 2.5.

[33] *See Agenda 21, supra* note 29 at ch. 2.5-2.8. *See also*, Jason Wiener, World Trade Organization's Identity Crisis: Institutional Legitimacy and Growth Potential in the Developing World (Dec. 21, 2004) (unpublished manuscript, on file with the author).

[34] *See Agenda 21, supra* note 29 at ch. 2.9. Chapter 33's "Financial Resources and Mechanisms" provisions are central to efforts that promote economic growth, social development and poverty eradication, but are only tangential to the scope of this paper. *Id.* at ch. 33. Chapter 33 rests on a General Assembly resolution 44/228, which essentially charged the United Nations Conference on Environment and Development with identifying and providing new financing mechanisms for environmentally sound research, projects and other developmental initiatives. *Id.* Under the "Means of Implementation" section financing in developed countries is left to the public and private sectors, and developing countries must rely on international aid transfers from developed countries, which must meet a target percentage of national GNP. *Id.* at ch. 33.13.

[35] *See Agenda 21, supra* note 29 at ch. 34. Chapter 34.1 provides: "Environmentally sound technologies protect the environment, are less polluting, use all resources in a more sustainable manner, recycle more of their wastes and products, and handle residual wastes in a more acceptable manner than the technologies for which they were substitutes." *Id.* at ch. 34.1.

how, procedures, goods and services, equipment, and organizational and managerial procedures.[36] To facilitate the spread of environmentally friendly technology, Chapter 34 acknowledges that:

> There is a need for favourable access to and transfer of environmentally sound technologies, in particular to developing countries, through supportive measures that promote technology cooperation and that should enable transfer of necessary technological know-how as well as building up of economic, technical, and managerial capabilities for the efficient use and further development of transferred technology. Technology cooperation involves joint efforts by enterprises and Governments, both suppliers of technology and its recipients. Therefore, such cooperation entails an iterative process involving government, the private sector, and research and development facilities to ensure the best possible results from transfer of technology.[37]

Increasing access to and transfer of technology is particularly important in developing countries to promote sustainable development, sustain the world's economy, to protect the environment and alleviate poverty and human suffering.[38]

Chapter 34 notes that a substantial body of technological knowledge lies in the public domain and that access to such knowledge in the developing world is crucial.[39] Further, this chapter considers the role of patent protection and intellectual property rights that adhere to environmentally sound technology, but it encourages exploring ways to ensure access for developing countries to such technology.[40] Chapter 34.11 explicitly addresses the availability of proprietary technology through commercial channels and recognizes its import for technology

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[36] *See Agenda 21, supra* note 29 at ch. 34.3. Chapter 34 is based on the notion that technology ought to serve the essential needs of humans and that regional differences in human resource development, capacity-building, gender, socio-economic conditions cultural and environmental priorities should be relevant to technology transfer. *Id.*

[37] *See Agenda 21, supra* note 29 at ch. 34.4.

[38] *See Agenda 21, supra* note 29 at ch. 34.5. Chapter 34 states as the primary goal of improved access to technology information, "to enable informed choices, leading to access to and transfer of such technologies and the strengthening of countries' own technological capabilities." *Id.* at ch. 34.8.

[39] *See Agenda 21, supra* note 29 at ch. 34.9.

[40] *See Agenda 21, supra* note 29 at ch. 34.10.

transfer.[41] In recapitulating this chapter's objectives, Agenda 21 resembles the principles set forth in the Rio Declaration and the UNFCCC.[42] In Chapter 34's "Activities" section, Governments are urged to encourage the private sector to promote effective modalities for access to and transfer of technology by: formulating policies for effectively transferring environmentally sound technology that is in the public domain; creating favorable conditions to encourage private and public innovation of said technologies; examining subsidies, tax policies, and regulations to eliminate impediments to the transfer of said technology; and a framework for transferring privately owned technologies to developing countries.[43] Chapter 34 conflates proprietary technology and technology residing in the public domain as mere alternative modalities for purposes of technology transfer, and, despite their competing philosophical value, both are vehicles for increasing access to technological knowledge and capacity for deployment.[44]

D. International Proliferation Treaty for Renewable Energies – Importance of Non-Governmental Organizations

A global non-governmental organization, named the World Council for Renewable Energy, has drafted a supplementary protocol to the Nuclear Non-Proliferation Treaty (NPT) of

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[41] *See Agenda 21, supra* note 29 at ch. 34.11. This chapter encourages exploiting the pool of proprietary technology and combining it with local innovations to generate alternative technologies. Further, "enhanced access to environmentally sound technologies should be promoted, facilitated, and financed as appropriate, while providing fair incentives to innovators that promote research and development of new environmentally sound technologies." *Id.*

[42] *See Agenda 21, supra* note 29 at ch. 34.14.

[43] *See Agenda 21, supra* note 29 at ch. 34.18.

[44] It is beyond the scope of this paper, however, Chapter 39 addresses the need to develop, update, contribute towards, increase participation in and clarify international legal instruments relating to the environment and relevant social and economic agreements. *See Agenda 21, supra* note 29 at ch. 39.1. Effective frameworks for technology transfer rely on well-developed and revered bodies of international environmental law. This chapter presupposes that the current state of international environmental and development law is ambiguous, disconnected, imbalanced, and underrepresented. To the extent that the multilateral and bilateral treaty system acts as a protector and stabilizer of global environmental and developmental interests, its lack of effective functionality hinders technology transfer to satisfy human needs.

1970.[45] While the International Proliferation Treaty for Renewable Energy (IPTRE) has not been submitted for a formal vote by the contracting parties to the Nuclear Non-Proliferation Treaty, the IPTRE illustrates the important work contributed by NGO's in promoting the use of renewable energy and demonstrates the relatedness of renewable energy to other global issues, such as international nuclear security. In light of the near unanimous global support for the NPT, the IPTRE would have enormous economic and legal implications if it were to be voted on as a supplementary protocol.

The Preamble to the IPTRE seeks harmony with the fundamental aims of Agenda 21 and addresses the myriad problems of utilizing fossil energies.[46] The Preamble acknowledges several related concerns, including *inter alia*: the destruction of vegetation zones; energy demand posed by growing populations; disproportionality of population and energy consumption; the public good nature of the environment; the inexhaustibility of renewable energies; and, the need to offer States opportunities to exchange scientific information and technical developments.[47] Article I would impose obligations on the contracting parties to exchange knowledge of renewable energy technologies and improved energy efficiency.[48] Article III would require the contracting parties to join the International Renewable Energy Agency (IRENA), which would serve as a clearinghouse for renewable energy technology, approve transfers of technology to improve energy efficiency and provide relevant services.[49] Article IV discusses development aid

[45] *International Proliferation Treaty for Renewable Energies*, World Council for Renewable Energies, *at* www.world-council-for-renewable-energy.org/downloads/Verbreitung-engl.pdf [hereinafter IPTRE]. The Nuclear Non-Proliferation Treaty has been signed by 187 States as of 2002 and has been in force since 1970. *See* http://www.un.org/Depts/dda/WMD/treaty/.
[46] *See* IPTRE, *supra* note 45 at prea.
[47] *See* IPTRE, *supra* note 45 at prea.
[48] *See* IPTRE, *supra* note 45 at art. I.
[49] *See* IPTRE, *supra* note 45 at art. III. The International Renewable Energy Agency (IREA) does not currently exist, however, the International Energy Agency addresses renewable energy issues. *See*

for renewable energy and action programs and Article V addresses international trade in renewable energies.[50] Article VI of the IPTRE would obligate States to determine the actuarial social cost of fossil and nuclear energies and prohibit States from taking discriminatory measures against another State that estimates the social cost of its domestic energy supply.[51]

II. Open Source Movement in Software Production

Since the advent of the personal computer nearly twenty-five years ago, two competing philosophical systems have battled for domination of what has become one of the most ubiquitous industries affecting every realm of society and humanity.[52] From these two schools of thought emerged contrasting legal regimes designed to protect the monopoly rights of authors on the one hand, and to ensure free public access on the other. Proprietary software conventionally involves payment for a single-use license to an individual end-user. These licenses typically rely on the full copyright protection afforded by law and prohibit unauthorized reproduction, or modification. Independent programmers who wish to make improvements must obtain highly coveted authorization to develop derivative software.[53] The software's kernal or core code is generally retained by the software's owners and hidden. In certain limited instances, commercial software developers authorize third-party developers to use layers of the proprietary software to promote compatibility with a wide range of software.[54] In the proprietary form,

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International Energy Agency, *at* http://www.iea.org/Textbase/subjectqueries/keyresult.asp?KEYWORD_ID=4116.

[50] *See* IPTRE, *supra* note 45 at arts. IV-V. The invocation that international trade is related to renewable energy dissemination resembles a central tenet of Agenda 21. *See supra* note 32 and accompanying text.

[51] *See* IPTRE, *supra* note 45 at art. VI.

[52] *See generally* Jonathan Zittrain, *Normative Principles for Evaluating Free and Proprietary Software*, 71 **U. Chi. L. Rev.** 265 (2003).

[53] *See* Zittrain, *supra* note 52.

[54] For example, Microsoft would enter into a license agreement with a third-party software company, such as Symantec, to enable programmers to write anti-virus software that can facilely inhabit the Microsoft Windows operating system environment.

commercial software enterprises rely on the existence and enforcement of copyright law and highly leveraged license agreements to capitalize on a given code package.[55]

Open source philosophy, on the other hand, began with the notion that source code should be "released without authorial restrictions on copying or derivation - a notion that could be accomplished by simply releasing one's work into the public domain…" and evolved "into software governed by a licensing scheme that would prohibit authors of derivations from placing restrictions on the distribution of their derived works that had not been placed on the distribution of the original code."[56] Richard Stallman, the father of the modern day open source movement, is credited with authoring GNU/Linux, which is a non-proprietary and widely used operating system that rivals the Microsoft Windows operating system.[57]

To prevent the "proprietization" of derivative software, Stallman created the General Public License (GPL), a legal form now used to license a myriad of free software.[58] GPLs and other similar licenses are designed to utilize the copyright convention to attach binding covenants to non-proprietary code to prevent authors of derivative software from imposing more restrictive copyrights on free software.[59] Other types of non-proprietary licenses impose no such "copyleft" restrictions, and may only require derivative software developers to give attribution or

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[55] *See* Zittrain, *supra* note 52, at 266, 269.
[56] *See* Zittrain, *supra* note 52, at 268-69.
[57] *Id.*
[58] *See* Zittrain, *supra* note 52, at 268. The General Public License (GPL) spawned a variety of non-proprietary licenses, but all contain certain basic elements, including: no royalty or other fee imposed on redistribution; availability of source code; right to create modifications and derivative works; requirement that modified versions be distributed as the original version plus patches; no discrimination against persons or groups; no discrimination against fields or endeavors; all rights granted must flow to/with redistributed versions; license applies to the program as a whole and each of its components; and, license must not restrict other software, thus permitting the distribution of open source and closed source software together. *See* Mark Webbink, *Understanding Open Source Software*, Groklaw, Dec. 31, 2003, *available at* http://www.groklaw.net/article.php?story=20031231092027900.
[59] *See* Zittrain, *supra* note 52, at 269. Open Source licenses can be classified into two categories. One type applies no restrictions on the distribution of derivative works (i.e. non-protective), and the second type applies restrictions that ensure that the code will always remain free and/or open. *See* Webbink, *supra* note 58.

credit to the original author.[60] Both "open" and "free" source licenses essentially seek to maintain public access to source code and to prevent developers from appropriating or privatizing the copyright of source code. Stallman believed that open source would become a social movement predicated on the notion that nonrivalrous goods should be free as a matter of ethics.[61] Today, open source firms are sprouting up with robust investment by venture capital firms that believe in the success of the open source methodology.[62]

The Open Source movement bases its philosophy on notions of reciprocity and collective action. To the extent that individual actors can be motivated by external incentives to contribute their labor, traditional economic theory suggests that the public good represents a contribution vaccum in which the well-known "free rider" effect discourages any action by individuals.[63] Reciprocity theory suggests conversely, that "[i]ndividuals who have faith in the willingness of others to contribute their fair share will voluntarily respond in kind."[64] Thus, one instance of cooperation breeds further and sustainable cooperation because individuals observe others

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[60] *See* Zittrain, *supra* note 52 at 269; Webbink, *supra* note 58; Severine Dusollier, *Open Source and Copyright: Authorship Reconsidered?*, 26 **Colum. J. L. & Arts** 281 (2003); Christian Nadan, *Open Source Licensing: Virus or Virtue?*, 10 **Tex. Intel. Prop. L. J.** 349 (2002). For purposes of this paper, both "open" and "free" source software will be referred to generally to contrast with proprietary software licenses, which reserve all rights to the author except a license to use the software on the licensee's computer.

[61] *See* Zittrain, *supra* note 52, at 274. Perhaps unintended, the open source philosophy is supplying alternative economic, political and legal structures for activists and social movements. *See* Jeffrey Juris, Cultural Production in a Digital Age: The New Digital Media and Activist Networking within Anti-Corporate Globalization Movements, 597 **Annals** 189, 191-92 (2005). Based on writings of social scientist Steven Weber, "open source could potentially revolutionize production within other information-based sectors, such as primary care medicine or genomics." *Id.* at 192. "The horizontal networking logic facilitated by new digital technologies not only provides an effective method of social movement organizing, it also represents a broader model for creating alternative forms of social, political, and economic organization." *Id.*

[62] *See* Gary Rivlin, Open Wallets for Open Source Software, **New York Times**, Apr. 27, 2005. Despite early difficulties, the open source software movement has gained considerable trust among venture capitalists following the large-scale success of Red Hat, which charges for support services, but develops source code under the open source license. *Id.*

[63] *See* Dan Kahan, *The Logic of Reciprocity: Trust, Collective Action, and Law*, 102 **Mich. L. Rev**. 71, 72 (2003).

[64] *See* Kahan, *supra* note 63, at 72.

contributing to the public good and therefore reciprocate based on the faith that contribution will become cyclically forthcoming.[65] In the context of intellectual property and technology, Professor Kahan suggests that academia is a prime example of the possibility of a reciprocal alternative to proprietary production.[66] Rewards, such as satisfaction from participating in shared intellectual projects, recognition and status, supply incentives for individuals to reciprocate production and exchange of ideas.[67] Critically, Kahan suggests that commercial enterprises often incorporate the academic model, which rewards reciprocity, collective action and idea exchanges by supplying internet portals, encouraging employees to attend academic conferences, and publish scholarly articles.[68]

Open Source programming is sustained by the same individual motivations that propel reciprocal intellectual production in universities.[69] The widespread popularity and the ever-expanding application of open source software substantiates the "reciprocity social theory" and suggests that open source code producers value peer recognition, status and the positive reputation accorded to valuable contributions.[70] In economic parlance, open source producers generate at least some utility from participating in reciprocal intellectual production systems, and thus, they can rely less on intellectual property rights to reward creativity and quality. In sum,

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[65] *See* Kahan, *supra* note 63, at 72.
[66] *See* Kahan, *supra* note 63, at 90. "Academics freely exchange ideas by teaching, attending conferences, and most importantly by publishing books and articles." *Id.* Kahan argues that the exchange of ideas is reciprocal because authors build on published work of their predecessors and because authors credit prior work with citations. *Id.*
[67] *See* Kahan, *supra* note 63, at 91.
[68] *See* Kahan, *supra* note 63, at 92. Information-intensive industries prefer that their researchers openly disseminate their ideas in order to attract the most talented researchers. *Id.* at 93.
[69] *See* Kahan, *supra* note 63, at 94.
[70] *See* Kahan, *supra* note 63, at 94.

Professor Kahan argues that reciprocal systems of collective action have broad and effective economic and legal applications.[71]

Open source is succeeding as a modality for software production because of the characteristics of the computation framework that make it feasible. That is, computer are shareable goods because they provide "functionality in discrete packages rather than in a smooth flow," and one must purchase some "threshold computation capacity" that delivers at least a minimum amount of computation whether all or some if is needed.[72] Another characteristic of shareable goods is the extent to which excess capacity exists which can be utilized in secondary markets, shared or managed- a notion Professor Benkler calls "granularity."[73] Sharing of such excess capacity involves relatively low transaction cost, improves the information on which "granular" resources act, and provide better motivation for exploiting excess capacity.[74] Benkler's shareability model supplies an attractive alternative to traditional market-based and institutional approaches to resources with certain characteristics, including: parallel processing, ease and cost of utilizing excess capacity, rapidity of resource's decay, and existence of secondary markets for overcapacity.[75]

III. Open Source as an Economic and Legal Modality for Renewable Energy Technology Dissemination

A. Economics

i. Demand-side Incentives

[71] *See generally* Kahan, *supra* note 63.
[72] *See* Benkler, *supra* note 3, at 276-77. Professor Benkler suggests that automobiles are similar examples of shareable goods because once purchased, a vehicle has the capacity to transport a certain number of people despite its occupancy at any given moment.
[73] *See* Benkler, *supra* note 3, at 277.
[74] *See* Benkler, *supra* note 3, at 277.
[75] *See* Benkler, *supra* note 3, at 290-300.

Traditional macro-economic theory suggests that where inadequate supply-side incentives exist, insufficient revenue or profit potential will discourage firms from entering a market to recoup initial investment. This can be especially true in the case of capital-intensive technologies where significant financial barriers to entry exist and where start-up costs are amortized over long periods of time. Open source industries, however, relies on demand-side incentives to drive competitiveness.[76] Ultimately, consumers' market choices will drive an industry that produces under different and competing theories of production. Further, since open source is a diffuse system of ad hoc software production, demand will also efficiently lead to product innovations because programmers will seek to deliver software updates and new code that addresses the current needs of consumers.[77] The open source method of producing software helps to defray the cost of innovation because ad hoc patches and updates can take the place of re-investing in research and development to program a full-fledged update.

Renewable energy technology fits squarely within this analytical paradigm. The industry is still fledgling and is stymied by enormous initial capital investment that small private firms are unable to recoup under traditional market conditions. Supply-side markets for renewable energy preclude the proper competition that allows the cost of technology to subside. If

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[76] *See* Ganesh Prasad, *Open Source-onomics: Examining Some Pseudo-economic Arguments About Open Source*, Linux Today, Apr. 12, 2001. Theory suggests that since consumers experience substantial cost savings by using open source software, there is a strong incentive to prefer open source software over proprietary counterparts. *Id.* Open source software has an advantage over proprietary systems in that it can develop "static efficiency" more quickly by pricing products at marginal cost- something proprietary developers cannot do because of the need to maximize profits and recoup costs. *See* Klaus Schmidt & Monika Schnitzer, *Public Subsidies for Open Source? Some Economic Policy Issues of the Software Market*, 16 **Harv. J. Law & Tec** 473 (2003).

[77] *See* Prasad, *supra* note 76. In proprietary software development, three external effects may distort incentives for innovation: (1) consumer surplus often stems from an innovating firm's inability to perfectly price discriminate, which causes it to be unable to recapture the entire increase in consumer surplus generated by innovation; (2) firms have difficulty gauging the cross-market applicability of innovations and thus the incentive to innovate does not reflect the full market potential of research and development; and (3) business-stealing effect, whereby superior technology makes some existing technology less attractive, can increase the cost of research and development or cause an over-investment in research and development. *See* Schmidt, *supra* note 76, at 480-81.

renewable energy technology were commoditized, as software has become by way of open or pure competition, demand-side incentives would drive production and would facilitate entry by smaller firms who could amortize their capital investment with newfound demand.[78] Empirically, open source technology flourishes in its own right, however, even when in competition with proprietary modalities open source has demonstrated its capacity to be a high quality and coveted alternative.[79] Linux has shown a steadily increasing consumer base since its advent in the mid 1990's and its platform for compatible products is growing as well.[80] Similar to the software industry, proprietary systems often lead to imperfect incentives for innovation due to the enormity of research and development investment. Microsoft has been embroiled over patent and copyright litigation in several countries largely due to its market prowess and because of stands at the apex of the software industry. Under a more diffuse system of technology development, innovation costs would decrease and producers could more readily achieve static and dynamic efficiency.[81]

Open source leads to increases in the "network effect" and decreases the switching cost among consumers.[82] Like with software, renewable energy has manifold cross-applications and when consumers adopt a particular type of technology, lower transitional costs could lead to increasing network effects in consumer, commercial, residential markets.[83] Further, since

[78] *See* Prasad, *supra* note 76.
[79] *See* Prasad, *supra* note 76; *see also* Rivlin, *supra* note 62.
[80] *See* Prasad, *supra* note 76; *see also* Rivlin, *supra* note 62. It is worth noting that Rivlin suggests that open source software firms have found a way to generate revenue by charging for the software support that accompanies dissemination of their open source code. *Id.*
[81] *See supra* notes 76-77 and accompanying text.
[82] *See* Schmidt, *supra* note 76, at 486-92. The network effect is the adoption of a good by different consumers. *Id.* at 486-488. The switching cost is the cost to a consumer of changing "platforms" that occurs by buying from different sellers. *Id.* at 490-492.
[83] *See supra* note 82 and accompanying text.

demand-side incentives increase supplier competition and drive down prices, the cost to consumers to switch technologies decreases correspondingly.[84]

ii. Public Incentives

Thus far, this paper has suggested that open source provides adequate incentives for development and innovation of competitive commodities such as software and renewable energy technology. Public subsidies or other government-sponsored incentives may, however, be necessary to stabilize and spur fledgling industries. Countries such as Germany, France, Italy, Taiwan, Norway, the European Commission and the United States have created some means of supplying incentives to open source development.[85]

Governments could choose to directly subsidize research and development, production and adoption of open source technologies.[86] Already, the U.S. government funds a large percentage of private research and development.[87] Under the notion that basic research, open source, and even renewable energy is a public good, for which the free market supplies inadequate returns, the government has a corrective role to play. Further, since most research and development occurs in universities or other public-research labs, non-monetary compensation have proven the most effective way to reward individual contribution.[88] Thus, the

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[84] *See supra* note 82 and accompanying text.
[85] *See* Schmidt, *supra* note 76, at 493. Thus far, it appears that most government intervention in connection with open source has focused on the software industry. Nevertheless, it is widely known that public subsidies also fund research and development into renewable energy technologies.
[86] *See* John Herrick, *Federal Project Financing Incentives for Green Industries: Renewable Energy and Beyond*, 43 **Nat. Resources J.** 77 (2003); Rae Kwon Chung, *The Role of Government in the Transfer of Environmentally Sound Technology, in* POSITIVE MEASURES FOR TECHNOLOGY TRANSFER UNDER THE CLIMATE CHANGE CONVENTION 47-48 (Tim Forsyth, ed., 1998). Government instruments to incent renewable energy development may include: renewable energy tax credits; federal ethanol incentives; private sector project finance participation; and, promulgation of renewable portfolio standards. Herrick, at 101-107.
[87] *See* Schmidt, *supra* note 76, at 494; Michael L. Katz & James A. Ordover, *R&D Cooperation and Competition*, 137-91 (Brookings Papers of Economic Activity, 1990).
[88] *See supra* notes 64-71 and accompanying text.

collaborative environment endemic to academia and high technology research labs facilitates public projects of the open source variety.[89]

iii. Public Sector Adoption of Open Source Technologies

Many governments are using their public procurement and spending powers to adopt open source technologies and restrict government agencies from using proprietary technology platforms.[90] Governments may force universities and government agencies to use open source products as alternatives to proprietary ones under the notion that open source products are qualitatively better and cost considerable less overall. For example, Brazil has become the first country to require any company or research institute that receives government subsidies to develop and license open source software.[91] President da Silva of Brazil appears poised to deploy open source computer technology to the masses by unveiling an open source project called "PC Conectado."[92] Governments could similarly require development, adoption, and licensing of open source energy projects pursuant its spending powers and widespread subsidization of the energy industry. Governments wield substantial influence over the energy industry because they are some of the largest consumers of energy.[93]

iv. Open Source Supply Initiatives

Open source has evolved as a paradigm of technological production and expanded beyond the ambit of software. The frontier of open source projects represents new opportunities for public subsidization because they are ripe for development and deployment. In the field of

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[89] *See supra* notes 64-71 and accompanying text.
[90] *See* Schmidt, *supra* note 76, 496; Hal Burman & Don Wallace, Jr., *New Frontiers for Private Law: Public Procurement, Infrastructure Projects*, 34 **ABA Int'l Law News** 5 (2005); Todd Benson, *Brazil: Free Software's Biggest and Best Friend*, **New York Times**, Mar. 29, 2005.
[91] *See* Benson, *supra* note 90.
[92] *Id.*
[93] *See* Herrick, *supra* note 86, at 107. In the United States, the federal government uses roughly 1.01 quads of power for its operations, which amounted to $7B in Fiscal Year 2000. *Id.*

renewable energy, materials science is on the verge of technological and scientific breakthroughs in silicon-based semiconductors, which forms the foundation for microprocessors and photovoltaic devices.[94] Moreover, advancements in semiconductor technology promote the cross-application or "network effect" of the materials science between computing and renewable energy technology.[95] Developments in the information technology industry to re-package software and computer technology to make it more user-friendly can be used to facilitate installation and use of renewable energy technologies, which may seem cumbersome and overly technical to operate.[96] The same human capital that has financed and developed open source software would readily and ably apply their expertise to the applied science of developing marketable renewable energy technologies.[97] Open source technology operations are ripe for public sector adoption because the technology is extremely low-cost, highly refined and functional, and buffeted by a capable information technology sector.[98] Open source renewable energy hardware projects are currently being undertaken in limited capacities and the technicians

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[94] *See* Brian McConnell, *Renewable Energy- The Next Opportunity for Silicon Valley*, O'Reilly Network, Dec. 10, 2004. The recent fortieth anniversary of Moore's law has brought renewed attention to the progress of technological innovation for silicon-based chips. *See Moore's Law on Chips Marks 40th*, BBC News, Apr. 18, 2005. Other examples of open source technology projects include a "super efficient battery charger and re-energizer," which is a variant of the Bedini SG. *See* Open Sourcing Projects, Pure Energy Systems, *at* http://www.pureenergysystems.com/os/index.html. This battery operates by extracting more energy than it uses. Pure Energy Systems has several inactive projects, including: "Bowman Magnetic Motot," "Ion Source Beam Projector," "Ed Gray Motor Variant by Gary Magratten," Charly Brown's Thermal Electric Chip," and a "Stirling Engine." *Id.* These projects demonstrate that open sourcing can propel research and development to the cutting edge. Additionally, open source practices are now being applied in the biotechnology field by developing techniques to create genetically modified crops without infringing on the patents of mega-biotechnology firms. *See* Andrew Pollack, *Open-Source Practices for Biotechnology*, **New York Times**, Feb. 10, 2005. The researchers who have published their findings in the "Nature" journal will release the genetic modification technique into the public forum for open use and innovation. *Id.* These researchers succeeded in modifying three types of bacteria to be used as hosts for desirable genes that could be inserted into three plants, rice, tobacco and Arabidopsis. *Id.* The open source initiative is called the Biological Innovation for Open Society, or BIOS. *Id.*

[95] *See* McConnell, *supra* note 94; *supra* notes 82-83 and accompanying text.

[96] *See* McConnell, *supra* note 94.

[97] *See* McConnell, *supra* note 94; *see also supra* notes 64-71 and accompanying text.

[98] *See* Rivlin, *supra* note 62 and accompanying text.

and researchers are collaborating through information sharing networks to disseminate their research and contribute to the public database of knowledge.[99]

In the realm of renewable energy related software, myriad applications are currently available in primarily proprietary format to analyze, database and simulate energy efficiency.[100] Software platforms that have applicability to renewable energy technologies are directly susceptible to aforementioned open source incentives.[101] Since renewable energy technology itself is constantly changing to meet industry demands, software applications must be continually updated and improved to reflect changing benchmarks of efficiency, different hardware applications and different hardware contexts. Thus, open source methodologies provide the necessary incentives to innovate software that accompanies renewable energy technologies in an ad hoc fashion.[102] Further, innovative renewable energy platform software may decrease the cost of deploying the actual technology because sophisticated simulation modeling could reduce the cost of testing, siting, and operating the renewable energy technology.

Beyond the software that complements renewable energy technology, collaborative research and data sharing can take place through electronic portals and databases for ongoing and completed research.[103] Open source developers frequently share their research to build a public database of knowledge to support open source software initiatives and the accompanying

[99] *See e.g.* Free Energy News, *at* http://freeenergynews.com/.
[100] *See* Building Energy Software Tools Directory, U.S. Department of Energy: Energy Efficiency and Renewable Energy, *at* http://www.eere.energy.gov/buildings/tools_directory/; RETScreen International, Natural Resources Canada, *at* http://www.retscreen.net/ang/menu.php.
[101] *See* note 64-71 and accompanying text.
[102] *See* note 64-71 and accompanying text.
[103] *See* RETScreen International, Software and Data, Natural Resources Canada, *at* http://www.retscreen.net/ang/d_o_view.php.

hardware applications. The use of electronic databases and bulletin boards is widely used by university researchers, private researchers and public sector researchers.[104]

B. Legal Licensing

Open source developers are more than idealistic individuals seeking to circumscribe the capital prowess of proprietary mega-developers. Open source licenses operate squarely within the context of the legal copyright structure to restrict the proprietization of source code.[105] Open source licenses, such as the GPL, Apache Software, the Free Software Foundation, the Public Patent Foundation, and the Electronic Frontier Foundation, utilize binding contractual covenants to maintain open source code in the public arena.[106] Litigation arising from open source licenses has been sparse in the United States, however, it is noteworthy that the anti-trust settlement between the Attorney General and the Microsoft Corporation, initially required Microsoft to release its "Internet Explorer" platform via open source.[107] One could explain the apparent lack of litigation of disputes arising under open source licenses by positing that individuals who partake in the open source movement and develop software in the public domain are relatively self-selecting. That is, open source developers write source code to contribute towards the "public good" and maintain a strong belief that software code ought to remain in the public domain.[108] Assuming that open source developers are those least likely to proprietize source

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[104] *See* notes 64-71 and accompanying text.
[105] *See* notes 56-61 and accompanying text.
[106] *See* GNU General Public License, *at* http://www.gnu.org/licenses/gpl.html; Apache License, *at* http://www.apache.org/licenses/LICENSE-2.0.txt. Open source licenses create binding contractual rights and obligations similar to proprietary software licenses. *Id.* *See also supra* notes 58-59 and accompanying text.
[107] *See Commonwealth of Massachusetts v. Microsoft*, 373 F.3d 1199, 1227-31 (2004). Ultimately, the D.C. Circuit Court overturned a District Court decision upholding the settlement agreement's requirement that Microsoft license its Internet Explorer through open source. *Id.* Nevertheless, it is substantial that at least one court upheld the validity of a settlement proposal to require a proprietary software developer to freely license one of its coveted software platforms through open source.
[108] *See* notes 64-71 and accompanying text.

code for individual profit, developers might freely enter into the open source license merely to memorialize a pre-established agreement founded on trust, collaboration and reciprocity.[109]

At the inter-governmental level, there is robust legal authority for States to compulsorily license technology and otherwise copyrighted information in order to promote access to and transfer of environmentally sound energy technologies.[110] The World Trade Organization ("WTO") has explicitly recognized the right of States to compulsory license technology as a way to promote access to technology that prevails in proprietary states.[111] States' authority to compulsory license technology that travels in the flow of international trade is predicated on the notion that legally enforceable intellectual property rights may at times interfere with a State's ability to protect its public welfare and to regulate multinational foreign direct investment.[112] For example, developing countries may compulsorily license proprietary renewable energy software owned by a multinational corporation to enable local firms to develop the know-how to develop and deploy energy technology to meet burgeoning demand. These local firms should then comply with the spirit of open source by preserving the software and hardware "source code" in the public domain so as not to undermine the multinational firm's intellectual property rights or to gain undue profits. Since the WTO recognizes the right of States to compulsorily

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[109] *See* notes 64-71 and accompanying text.

[110] *See Declaration on the Trade Related Aspects of Intellectual Property Rights Agreement and Public Health* [hereinafter Declaration on TRIPS], WT/MIN(01)/DEC/2, para. 5-6 (Nov. 20, 2001); Markus Nolff, *Paragraph 6 of the Declaration on the TRIPS Agreement and Public Health and the Decision of the WTO Regarding Its Implementation: An "Expedition Solution"?,* 86 **J. Pat. & Trademark Off. Soc'y** 291 (2004); Thomas Haag, *TRIPS Since DOHA: How Far Will the WTO Go Toward Modifying the Terms for Compulsory Licensing?*, 84 **J. Pat & Trademark Off. Soc'y** 945 (2002). *See also supra* note 43 and accompanying text.

[111] *See* note *110 and accompanying text.*

[112] *See* Declaration on TRIPS, *supra* note 110 and accompanying text; UNCTAD, THE ROLE OF PUBLICLY FUNDED RESEARCH AND PUBLICLY OWNED TECHNOLOGIES IN THE TRANSFER AND DIFFUSION OF ENVIRONMENTALLY SOUND TECHNOLOGIES, Background Paper No. 22 to the Sixth Session of the CSD, para. 106(a) (1998), *available at* gopher://gopher.un.org:70/00/esc/cn17/1998/background/22unctad.bgp; *supra* note 32 and accompanying text.

license technology that is otherwise protected by intellectual property rights to promote public health in the flow of international trade, the State's conduct would not be subject to WTO sanctions as unfair trade activity.

Use of a State's compulsory licensing authority in the context of renewable energy technology lowers the legal and economic barriers that market-based technology enjoys on account of intellectual property rights. Further, compulsory licensing authority is a primary legal mechanism that governments may employ in taking steps to promote access to renewable energy technology. Thus, States should prevent traditional intellectual property rights from interfering with their obligations under international environmental technology transfer treaties by exercising inherent economic rights to compulsorily license Trade Related Aspects of Intellectual Property Rights Agreement ("TRIPS")-related technology within the international trade regime.[113]

Judicial enforcement of the binding effect of open source licenses and affirmation of the legislature's authority to compulsorily license open source renewable energy technology depends in part on the extent of a government's obligation under international law to promote the international transfer of renewable energy. Open Source methodologies, manifested in the renewable energy software and technology industries, will only be legally recognized and therefore economically viable if legislatures and judicial bodies enforce open source instrumentality as binding. The multilateral renewable energy technology framework must be said to create binding international legal obligations on governments in order to hold States accountable for their effort to promote the transfer and dissemination of renewable energy.

Although the Rio Declaration and Agenda 21, which both arose from the 1992 Rio Conference, are essentially aspirational declaration of a global policy consensus, the United

[113] *See supra* note 110 and accompanying text; *supra* note 32 and accompanying text.

Nationals Framework Convention on Climate Change creates binding obligations on the part of governments to affirmatively promote renewable energy technology.[114] Article four of the UNFCCC speaks with obligatory language in a way that appears to evince the drafters' intent to create binding obligations on governments.[115] Article four uses terms such as "shall promote and cooperate," and "shall take all practicable steps to promote, facilitate and finance" to articulate the Convention's intent to obligate governments to affirmatively undertake renewable energy technology transfer initiatives.[116]

When the UNFCCC is viewed in light of the Rio Declaration and Agenda 21, it is evident that the member states intended the UNFCCC to create *legal* obligations as opposed to expressing a philosophical or political understanding.[117] The existence of the Rio Declaration and Agenda 21, as political expressions of a global environmental and technological consensus, and the UNFCCC as a legal instrument creates a coherent legal and political paradigm designed to guide member states and to hold them accountable for derogation. While the UNFCCC's language may be said to create legal obligations on the part of member states, it appears to stop short of evincing an intent to be immediately "self-executing."[118] The language of the UNFCCC suggests that Article four was intended to be non-self executing because such terms as "shall take all practicable steps," and "shall promote and cooperate" connote progressive

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[114] *See* notes 20-28 and accompanying text. *See also* Gaetan Verhoosel, *Beyond the Unsustainable Rhetoric of Sustainable Development: Transferring Environmentally Sound Technologies*, 11 **Geo. Int'l Envtl. L. Rev.** 49, 58-65 (1998); *see also supra* note 43 and accompanying text.

[115] *See* notes 20-22 and accompanying text.

[116] *See* notes 20-22 and accompanying text.

[117] *See* Verhoosel, *supra* note 114, at 58-62; *supra* note 43 and accompanying text.

[118] The "self-executing treaty" doctrine refers to whether a treaty creates a *de facto* rule of decision for a state's judicial branch. *See Foster & Elam v. Neilson*, 27 U.S. 253 (1829). Domestic law is often the source of a state's internal definition of what constitutes a "self-executing" treaty. *Id.* Where a treaty is said to not be "self-executing" a state's legislature must affirmatively pass enabling legislation that makes the relevant treaty a judicial rule of law. *Id.* Otherwise, a "self-executing" treaty becomes a *de facto* judicial law without further legislative action. *Id.*

implementation of the treaty's obligations.[119] A government is ordinarily said to "take steps" when it passes domestic legislation or promulgates administrative regulations, and such steps must only be "practicable" and "appropriate" under Article four of the UNFCCC.[120]

The UNFCCC does not appear to create burdensome or costly obligations on member states, but provides that they shall affirmatively promote the transfer of renewable energy technologies. Government support for open source renewable energy software and hardware technology is entirely consistent with the spirit of the UNFCCC and the elucidating policy declarations that accompanied it.[121] Further, performance under the UNFCCC appears to be bilateral and conditional on mutual cooperation.[122] The Treaty requires proportional compliance by developed and developing countries in that effective implementation of treaty obligations by developing countries depends on the performance by developed countries of their responsibility to provide financial resources and technology transfer.[123]

IV. Conclusion

The spate of recent media reports addressing rising energy costs in the developed world reveal a deeper divide between the progress of energy technology being innovated and deployed under proprietary legal regimes and environmental degradation and human suffering. Developing countries and consumers in developed ones are struggling to achieve autonomy and to define their fates while at the behest of multinational behemoths that possess the technological key to human progress. The international community has convened with regularity to address how technology can be utilized to ameliorate human suffering, energy geopolitics, and environmental degradation. The product of these conferences has been an emerging global

[119] *See* notes 20-22 and accompanying text.
[120] *See* notes 20-22 and accompanying text.
[121] *See supra* note 43 and accompanying text.
[122] *See* UNFCCC, *supra* note 10, at art. 4(7); Verhoosel, *supra* note 114, at 58-62.
[123] *See* UNFCCC, *supra* note 10, at art. 4(7); Verhoosel, *supra* note 114, at 58-62.

framework that values sharing, reciprocity and collective action over unbridled intellectual property rights. Meanwhile, developed countries seek to expand these intellectual property right protections in regions where such rights interfere with the ability to meaningfully deploy technology that could facilitate environmentally-friendly development.

The open source software movement is coming of age and expanding into industries beyond its roots in the software field. Valuable innovations in the biotechnology field, applied software and mechanics field and mechanical energy technology field have arisen under open source methodology. Under the international environmental treaty framework, States have obligations to promote the transfer and dissemination of renewable and environmentally friendly technology. Governments should employ the panoply of legal and economic tools available under and sanctioned by international law to meet consensual multilateral obligations. Open source technology initiatives should be nurtured by public incentives, public sector procurement projects and legal alternatives to traditional intellectual property right protection.

Legally indoctrinated preferences for unbridled intellectual property rights have created uneconomic and non-competitive barriers to entry and legal inequality, thereby preventing the widespread development, deployment, adoption and transfer of renewable and environmentally friendly technology. As international law progresses to re-define States' obligations vis-à-vis technology transfer and the global environment, States must update their incentive mechanisms to nurture frontier technological movements. Only governments, through economic primers and law, can reduce the widening deficit between technological progress and environmental and human destruction and a global consensus obligates them to do so.