Patents: Taken for Granted in Plans for a Global Biofuels Market

Climate change mitigation and reducing petroleum dependence are the most publicized imperatives for increasing biofuels production. But some governments also cite rural development, increased employment, and efficient use of agricultural plant and animal residues, among other rationales for developing a global biofuels market. Entrepreneurs and trade lobbyists tout rules to liberalize biofuels trade as a way to resolve differences over agricultural subsidies and restart the Doha Round of World Trade Organization (WTO) negotiations.[1] Toward replacing a small but increasing part of petroleum-based fuels with biomass-derived fuels, governments, United Nations agencies, publicly funded international financial institutions and private firms are investing in the creation of global and regional biofuels markets, perhaps most prominently through the recently launched Global Bioenergy Partnership.[2]

"[I]n 2004, total ethanol trade was around 3 billion litres, total ethanol production was around 32 billion litres and total crude oil trade was around 920 billion litres."[3] In 2005, Europe produced about 89 percent of all bio-diesel, with Germany alone producing 54.5 percent.[4] In 2006, the U.S. led the world in ethanol production with 4,855 million gallons, Brazil produced 4,491 million gallons, followed by China (1,017 million gallons) and India (502 million gallons). [5]

In relation to this "fast moving train," there is little public discussion about patent policy and the cost of patent royalties and licensing fees in the development of biofuels, whether globally traded or locally produced for local consumption. In official documents and international initiatives, there is also little mention of patents as part the global biofuels market. For example, in the "Brazilian Agroenergy Plan 2006-2011," there is not a single word about patents. Within the United Nations Energy task force report "Sustainable Bioenergy: A Framework for Decision-Makers," neither patent policy, patent enforcement, royalty and licensing fee costs, nor the role of traditional knowledge and genetic resources in patented biomass products are considered to be sustainability factors. In UN Food and Agriculture Organization's "International Bioenergy Platform," patent issues are not part of its "knowledge management" program nor of its bio-energy assessment.[6] The Office of the U.S. Trade Representative review of trade barriers to products that it claims reduce the intensity of greenhouse gas emissions is concerned with patents only to ensure the enforcement of U.S.-granted patents in traded products.[7] Patents are left out of the equation when, in fact, they should be one of the most central components for consideration.

UTILIZING GM CROPS FOR BIOFUELS

The proliferation of genetically modified (GM) crops is a prominent concern in international development debates. Because much of the feedstocks to be developed for biofuels are already genetically modified, communities are concerned about the long-term negative impacts on health, biodiversity, traditional knowledge as well as the environment. For the most part, the modifications are not yet biofuels-specific but merely tied to a currently patented trait, most often resistance to a patented pesticide or inclusion of an insecticide in the plant. However,

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varieties with patented traits intended for biofuels production are emerging. Syngenta has applied in Europe and South Africa for permission to import a maize variety containing an enzyme that rapidly breaks down starch, thus improving ethanol production efficiency and presumably lowering production costs.[8] Because grain handling and transportation systems do not segregate grain and oilseed shipments according to their intended use, the likelihood that the Syngenta variety would adulterate food maize was cited as a reason for the import permit denial in March in South Africa.[9]

In 2008, Monsanto plans to sell a GM maize variety with high starch content for ethanol production.[10] In 2009, Monsanto hopes to commercialize GM sugar cane varieties resistant to its RoundUp Ready pesticide.[11] All of these genetic modifications of crops have been or will be patented to grant commercial monopoly privileges to the patent holder and to protect the patent holder from unlicensed and unremunerated use of the patented product. According to an industry consultant, patents granted in industrial biotechnology, largely for biofuels production, increased from 6,000 in 2000 to 22,000 in 2005, with several thousand patent applications awaiting approval. This same consultant declared, "The biofuels gold rush is on, with many staking claims."[12] Many of the claims are based on patents.

GM biomass feedstocks pose huge regulatory and patent policy challenges that may impede the biofuels gold rush. For example, in preparation for the Convention on Biological Diversity (CBD) meeting in May 2008 in Bonn, Germany, biotech companies are expected to argue that the CBD should remove its ban on genetic seed sterilization (known more commonly as Terminator Technology). The companies will argue that the ban must be lifted in order to prevent gene flow of biofuel feedstocks from contaminating food crops. The European Commission (EC) is spending $6.8 million on a Terminator variant in the Transcontainer Project. The EC aims to make GMOs acceptable to EU consumers by enabling alleged co-existence of GM and non-GM crops through "containment" of GMOs while still putting the legal burden on the farmer for maintaining co-existence. The main beneficiaries of the EC investment of public money in the new Terminator will be Monsanto, DuPont, and Syngenta, which collectively control about 44 percent of all seed patents.[13]

The EC Transcontainer Project raises questions about the consequences for food security and biodiversity of giving CBD approval to Terminator technology. Furthermore, it raises questions about what the public can do when the state finances research for a product to which the public has frequently voiced its opposition. If the EC continues to invest in the new Terminator technology and develops a product or process for which it claims a patent, or turns over publicly funded research so that a company can apply for a patent, how does the public assert its interest in the patent application process? To answer such a question, patent policy reform advocates will need to find ways of asserting the public interest in the traditionally private dialogue between the patent examiner and the patent applicant.

MOVING TOWARD CELLULOSIC

"We are nearing the end of the [U.S.] corn-to-ethanol era. Ethanol production has doubled since 2005 and will double again by 2010. It is unlikely that any new corn-to-ethanol plants will be built beyond those currently in the construction pipeline. [As a result of U.S. congressional mandates] after 2012, all additional ethanol capacity [beyond the mandate] must be based on non-corn crops." David Morris: "Give Ethanol a Chance: The Case for Corn-Based Fuel." Alternet. June 13, 2007.

Cellulosic biomass production is being developed for the second generation of biofuels crops.

So-called second generation biofuels are beginning to be produced from cellulosic fibers in crop residues, such as corn stover (mostly stalks, leaves and husks) and wheat straw left in the fields after harvest, or from timber or lumber residues. Some of the proposed plants also are planning to use dedicated energy crops and municipal solid waste as sources.

The first demonstration cellulosic ethanol plant (3 million liters a year) is run by Iogen Corporation in Ottawa, Canada, but it consumes more energy than it produces because of the resistance of cellulose fiber to ethanol processing by current enzyme technologies.[14] Another commercial-scale plant to produce ethanol from cellulosic fiber is under construction in Spain.[15] Several plants are under construction right now in the U.S. – including the Poet plant in Iowa that will produce ethanol from both corn and corn stover/corn cobs.

Many claim that cellulosic biofuels would reduce land-use competition with biofuel feedstocks that also have feed and food purposes, require fewer inputs, and yield more biomass with less environmental damage.[16] Governments, as well as private firms, are investing in the technology. For example, the U.S. Department of Energy is offering $160 million in grants to fund up to 40 percent of the construction costs of three cellulosic ethanol demonstration plants.[17] Loan guarantees have also been extended to a number of plants around the U.S.

According to industry officials, two main bottlenecks to the development of commercial-scale cellulosic biofuels production, enzyme cost and enzyme versatility, are being overcome. (An enzyme is protein prompting a bio-chemical reaction, usually to accelerate the reaction.) Novozymes, an enzyme company, claims to have developed an enzyme that can process various feedstocks for bio-diesel production.[18] U.S. government investments in cellulosic ethanol in the 1990s failed to produce commercially viable operations, but further government investments and more that $200 million in private investments in early 2007 alone have renewed hope for the technology's commercial success.[19]

Monsanto is developing new switchgrass varieties in a joint venture with Ceres, a company that intends to breed into switchgrass "attributes ideally suited to being farmed on large acreages to produce consistently higher yields."[20] DuPont, the world's second largest seed company, has developed a high-starch maize variety that will include a micro-organism developed by Diversa, engineered to convert corn stover into ethanol. The partnership of a large agribusiness firm with a small company specializing in en-

zyme bio-chemistry is characteristic of biofuels joint ventures.

COMPANIES DEVELOPING CELLULOSIC AGROFUEL ENZYMES AND THEIR CORPORATE PARTNERS

Diversa/Celunol
Syngenta, Dupont/Tate&Lyle, Khosla Ventures

Iogen
Shell, Goldman Sachs

Genencor (Danisco)
Tembec, Mascoma/Kohsla Ventures, Cargill, Dow, Royal Nedalco

Novozymes
DuPont, Broin, COFCO. China Resources Alcohol Corp.

Dyadic
Abengoa, Royal Nedalco

Source: Grain. "Agrifuels and the Expansion of Agribusiness." SEEDLING. July 2007. http://www.grain.org/seedling_files/seed-07-07-3-en.pdf

The research phase of product development is primarily the responsibility of the smaller firm, while the product commercialization, and the securing and enforcement of patents, is carried out by agribusiness firms. If a patent office denies a patent application, the immense legal departments of multinational corporations have the resources to file appeals until the patent sought is granted. Joint ventures constructed on the basis of the licensing of patents have enabled cartelistic monopolies in the chemistry, biotechnology and pharmaceutical industries. Patent scholar Peter Drahos calls these ventures "biogolopolies."[21] In the absence of enforcement of anti-competitive business practice law and the lack of WTO rules against anti-competitive business practices, such joint ventures are perfectly legal.

University research in "partnerships" with multinational corporations often transfer publicly funded investigation to the private sphere via a licensing arrangement, in exchange for which the university receives corporate grants to continue to do research. Some of these university-corporate partnerships, such as the $500 million, ten-year deal between British Petroleum (BP) and the University of California-Berkeley to create an Energy Bioscience Institute, are very controversial. That deal would allow BP to retain patents developed by BP scientists in a $40 million facility to be provided by California taxpayers. BP would share royalties on patents developed in cooperation with university scientists. Some of these patents would concern techniques of synthetic biology to engineer plants at the molecular level to break down cellulosic fiber resistance to enzymes.[22] Whereas molecular biology moves genes between species (e.g., a fish gene into a tomato), synthetic biology techniques move molecules to create "operating systems" in living organisms. The molecular operating systems are first designed on a computer and then are replicated as genetic "circuits" constructed with parts of DNA.[23]

In the not too distant future, perhaps by 2015, there may be genetic modifications specific to producing cellulosic biofuels, such as breeding into trees or grasses enzymes or microbes to break down cellulose to extract sugars for ethanol. Breeding enzymes or microbes into the biofuels feedstock eventually would replace the current technique of adding enzymes to the biomass slurry mix and liquefaction tanks. The application of synthetic biology to enzyme chemistry would design an organism molecule by molecule— for example, by "rewiring" the "genetic networks in a cellulose-crunching bug found in the gut of termites."[24] These designer organisms, when bred into the cellulosic feedstock, would eliminate current processing steps, resulting in a far cheaper and greater volume of ethanol. Aristides Patrinos, formerly associate director of the U.S. Department of Energy's (DoE) Office of Biological and Environmental Research and now president of Synthetic Genomics, says "the ideal situation would essentially just be one big vat, where in one place you just stick the raw material -- it could be switchgrass -- and out the other end comes fuel."[25] The technological success of synthetic biology is assumed in the DoE target of replacing 30 percent of U.S. transport fuel usage by 2030, increasing the 5 billion gallon ethanol production capacity in 2006 to 60 billion gallons by 2030.[26]

COMPANIES WITH SYNTHETIC BIOLOGY ACTIVITIES (RELATED TO BIOFUELS PRODUCTION)

Amyris Biotechnologies
Developing synthetic microbes to produce pharmaceuticals, fine chemicals, nutraceuticals, vitamins, flavors and biofuels.

Codon Devices
Designing and constructing engineered genetic devices for partners in medicine, biofuels, agriculture, materials and other application areas.

Diversa
Adds new codons to "optimize" enzymes taken from natural bacteria to apply to industrial processes.

DuPont
Partnering with Genencor, BP, Diversa and others to develop microbes that will produce fibers and biofuels.

LS9
Designs microbial factories that produce biofuels and other energy related compounds.

Mascoma
Develops microbes to convert agricultural feedstock into cellulosic ethanol.

Synthetic Genomics
Develops minimal genome as chassis for energy applications.

Source: ETC Group, "Extreme Genetic Engineering: An Introduction to Synthetic Biology. January 2007. http://www.etcgroup.org/upload/publication/602/01/synbioreportweb.pdf

Patent claims on synthetic biology products and processes have been so broad and the licensing of patent use so complex that a May 2006 editorial in *Scientific American* warned that those patenting and licensing practices could undermine the discipline. Broad patents, if enforced, could result in expensive licensing, draconian limits on scientific communication among patent licensees, and/or time-consuming circumvention to avoid patent violation.

Biotechnology industry patent claim practices will almost certainly be applied as broadly as possible to biomass for biofuels. Broad patents are filed or purchased not for product development, but to enable "strategic use" of those patents to prevent competitors from developing products.[27] Broad patents, such as Monsanto's patent on the genetic modification of all soybean varieties, are occasionally revoked. However, the patent holder retains the financial benefits of the broad patent filing prior to revocation, so there are no financial disincentives for broad patent claims or "strategic use."[28] Hence, it seems likely that the patenting strategy of biomass intended for biofuels will follow anti-competitive "strategic use" patents, as long as patent offices grant such broad patent claims and there is no punishment for making such broad claims.

PROTECTING INTELLECTUAL PROPERTY: A FACET OF INVESTMENT PROTECTION

Investment in and commercialization of the agricultural biotechnology products outlined above depend to a considerable degree on government regulations to instill consumer confidence and foster markets for biotech products. Absent such rules, investors are reluctant to assume the risks of investing.[29] The context for the following analysis of patent policy issues affecting biomass for biofuels production are the regulatory initiatives, investments and loans of governments and intergovernmental institutions to expand biofuels production and consumption. The initiatives seek to transform what has been largely a domestic industry, dominated by Brazil and the United States, to an export-oriented industry within a global trade liberalization framework. Liberalized trade regimes generally grant protections to just two kinds of entities, intellectual property holders and private investors, usually transnational corporations.

Governments seeking private investment offer investment protections, including intellectual property protection, to reduce investor risk. For example, according to the "Brazilian Agroenergy Plan 2006-2011," "it is essential to minimize risks for private investors and, at the same time, maximize the efficiency of the investment projects,"[30] efficiency being measured in terms of rate of return on investment. One way that Brazil and other governments hope to entice private investment for biofuels trade is through publicly funded provision of transportation and storage logistics for companies to use.

Another, unmentioned, way to minimize private investor risk is through the protection of intellectual property (IP), defined as "investment" in bilateral investment treaties (BITs) and free trade agreements (FTAs). BITs and FTAs go "beyond" the WTO Agreement on Trade Related Intellectual Property Rights (TRIPs) in ways that will affect the development of biofuels industries in developing countries. One legal scholar notes, "investment agreements tend to be TRIPS-plus or to undermine the regulatory discretion of countries in relation to measures regulating practices of IP rights holders."[31] For example, under FTA, patents are defined as "investments" and patent holders are authorized to sue parties through the FTA for lack of effective enforcement of the patent holder's rights. Investors may also sue states for alleged violations of right to patent products developed from genetic resources accessed by an "investor" under contract.[32]

A microbe collected in a bio-prospecting expedition would be an "investment" regardless of whether or not it results in a patented product (e.g., a fermentation catalyst for biofuel). But in the midst of the anticipated multi-billion dollar biofuels investments and diplomatic efforts to offer investors maximum protection, there is little discussion about how the public interest and investment in biofuels can be protected.

SOME TRANSNATIONAL CORPORATIONS INVESTING IN AGROFUELS

Agribusinesses: ADM; Cargill; China National Cereals, Oils and Foodstuffs Import & Export Corporation; Noble Group; DuPont; Syngenta; ConAgra; Bunge; Itochu; Marubeni; Louis Dreyfus.

Sugar: British Sugar; Tate & Lyle; Tereos; Sucden; Cosan; Alco Group; EDF & Man; Bajaj Hindusthan; Royal Nedalco.

Palm Oil: IOI; Peter Cremer; Wilmar

Forestry: Weyerhaeuser, Tembec

Oil: British Petroleum; Eni; Shell; Mitsui; Mitsubishi; Repsol; Chevrom; Titan; Lukoil; Petrobras; Total; PetroChina; Bharat Petroleum; PT Medco; Gulf Oil.

Finance: Rabobank; Barclays; Societe Generale; Morgan Stanley; Kleiner Perkins Caufield & Byers; Goldman Sachs; Carlyle Group; Kohsla Ventures; George Soros.

Source: Grain. "Agrifuels and the Expansion of Agribusiness." SEEDLING. July 2007. http://www.grain.org/seedling_files/seed-07-07-3-en.pdf

CLIMATE CHANGE, INTELLECTUAL PROPERTY AND BIOFUELS

Because trade liberalization and its alleged public benefits remain controversial, furthering trade liberalization is seldom presented as a reason for increasing biofuels production globally. Instead, the rationale for a global biofuels industry most often has been to reduce the emission of greenhouse gasses (GHG), chiefly carbon dioxide, and thereby mitigate the environmental and economic effects of climate change.

What policymakers seem to miss in their support of global biofuels trade is that if it is based on existing models of production in agriculture, including using GM crops and chemical-intensive growth, the potential to have a positive impact on the environment is minimal. Additionally, a global biofuels trade system pushes the industry away from a more locally owned and locally used system, where local owners have a greater incentive not to damage the environment, since it is their land and their neighbors' land on which biomass for biofuels would be grown. If more land is used for biofuels feedstocks for global trade, one can expect even more loss in terms of agro-biodiversity, indigenous rights and global ecosystem health.

Both the United Nations Millennium Ecosystem Report and the fourth International Panel on Climate Change assessment present strong evidence that further deforestation and peat bog

burning could trigger catastrophic GHG releases with irreversible ecosystem effects. Given the climate effects of deforestation and peat bog burning to create soy, sugarcane and palm oil plantations, particularly in Malaysia, Indonesia and South America, further land clearing for biofuels expansion could provide the tipping point for non-linear and irreversible global ecosystem damage.

Governments in the Bioenergy Partnership and elsewhere have declared their intent to ensure that that the production of biomass feedstocks and biofuels processing is environmentally sustainable. Yet none of the net energy biofuels life cycle studies, nor the certification standards and reporting mechanisms for sustainable biofuels production, have taken into account the macro-affects of deforestation and peat destruction for existing or planned biofuels plantations.[33] Projects to convert power plants to run on certified sustainable biofuels have been cancelled for want of a sufficient certified supply. Investment advisors are starting to factor sustainability into investment advice, though the effect of such advice on investors is not clear.[34]

The case study evidence of biofuels investment plans, particularly in developing countries, shows that there is little foresight about the extremely high environmental costs of biofuels production among government officials who are looking for land and other natural resources on which investors would locate biofuels plantations. Over the next 15 years, a Brazilian sugarcane processor expects that a third of all Brazilian pasture land, some 100 million hectares, will be planted to sugarcane.[35] Currently, about 22 million hectares are planted to soy, 6 million to sugar cane and 3 million to eucalyptus (for vegetable charcoal) in Brazil. That 31 million hectares is equivalent to the land mass of Holland, Belgium, Luxembourg and the United Kingdom combined. About 40 percent of Brazilian sugarcane is processed into ethanol.[36]

In addition to the environmental destruction wrought by deforesting to produce biofuels feedstocks, the indigenous people forced from the land take with them traditional knowledge about biological resources that could be of far greater value than that of the biofuel feedstock. Perhaps as many as 60 million indigenous people will be driven from their lands, under customary ownership, to clear the way for biofuels plantations, if current investment plans are realized.[37] Thus is the human rights violation of dispossession compounded by the loss of perhaps irreplaceable traditional knowledge that, furthermore, might have great economic value if it were used to develop licensed products. Despite the environmental damage and human rights violations that have occurred as a result of deforestation for mono-cropping, advocates of a global biofuels market serenely dismiss the risks of current and planned biofuels investments as "speculative at present" and argue for the need to "create a level playing field for trade in biofuels."[38]

U.S. PATENT PRACTICE AND THE TRADE RULE CONTEXT

Generally speaking, patent offices are institutionally biased toward granting patents. Like WIPO itself, in many cases their funding depends to a great extent on annual fees for registering and renewing grants of patent.[39] The length and complexity of patent applications ensure that understaffed examiners, such as those in the U.S. Patent and Trademark Office (PTO), have very little time – just 20-30 hours per application on average - to examine documentation and determine whether the patent claim meets the basic criteria for granting a patent.[40] As a result, satisfying the basic criteria for the granting of patents is sometimes exceedingly easy. As expressed in Article 27. 1 of the WTO agreement on intellectual property, these criteria are that products or processes be "new, involve an inventive step and are capable of industrial application." WTO members are to grant patents to applicants who fulfill these basic requirements, usually characterized as novelty, non-obviousness and utility. Given the resource constraints and institutional biases of patent offices, as one U.S. biotech patent lawyer put it in 1999, "you can get utility if you can spell it.'"[41]

There is mounting concern among patent scholars that patents, particularly in the United States, are being granted on the basis of trivial, dubious or even fraudulent claims to satisfy the basic patent criteria outlined in national law, as reflected in TRIPs. Two scholars have dubbed the legal culture in which such claims have been filed, granted and extended the "patent pathology" and have charged that that the pathology is endangering the very capacity for innovation that patents are supposed to promote.[42]

While the U.S. courts and the Patent and Trademark Office have taken a few small steps toward reforming the patent system, regulatory and judicial proceedings still do not allow for public interest intervention to prevent dubious grants of patent or to re-examine the validity of patents granted. More systemic patent reform requirements should safeguard the public interest and investment, together with institutionalized venues for public interest intervention.

The U.S. Supreme Court recently ruled (KRS International Inc. v. Teleflex Inc. et al) that patent applicants had to better document that their patent claims fulfilled the requirements for grants of patent,[43] implicitly conceding some arguments made by critics of "patent pathology." Ironically, just as there is some judicial and regulatory momentum to counteract "patent pathology," the United States is exporting a more draconian version of its unreformed patent system through bilateral trade agreements.

For example, as a result of U.S. demands in its free trade agreement with El Salvador, the El Salvadoran legislature was obliged to change 108 provisions in its intellectual property law, about half of that legal corpus. The "reforms" include permission to patent natural and genetic resources; fines, jail sentences and seizure of bank accounts for violators of intellectual property rights; violator payment of anticipated profits and the legal fees of IPR holders; presumption of guilt when charged until proven innocent; and publication of IPR convictions in the national press. Whereas intellectual property violations were previously adjudicated as misdemeanors in civil court, they are now treated as major crimes (delitos graves) in criminal court.[44]

If the El Salvadoran government neglects to punish its citizens sufficiently to protect IPR holder privileges, the holders can initiate demands for compensation and other sanctions from the government under the investment chapter of the Dominican Republic-Central American Free Trade Agreement (DR-CAFTA), where IPRs are defined as investment (Article 10.28). Lack of government resources to enforce the DR-CAFTA IPR chapter provides no legal protection against an investor lawsuit against any government in CAFTA (Article 15.11.2). Hence protection of intellectual property will take precedence over use of other government funds, which will be depleted by elimination of most tariffs under DR-CAFTA.

DR-CAFTA requires many and great changes in areas of Central American and Dominican Republic law that extend beyond commercial law. However, U.S. legislation to implement its WTO commitments requires that in the event of conflict with WTO rules "unless and until Congress or the Executive Branch, as the case may be, takes action to modify or remove the statute, regulation or regulatory practice at issue," U.S. law prevails over international trade commitments.[45] The U.S. does not grant to other parties in bilateral or regional trade agreements the governmental policy discretion or "policy space" that it arrogates to itself. Therefore, systemic patent reform, such as that proposed in WIPO's Agenda for Development, will have to overcome these bilateral rules against "policy space."

PATENT REFORM AND ASSERTING THE PRIMACY OF THE PUBLIC DOMAIN

No amount of patent reform, of course, can prevent irrational land clearing and agricultural practices for biomass for biofuels. Such prevention has to come from governments asserting public prerogatives against the use of property rights to harm public goods, such as air quality and GHG mitigation. In some cases, this more general assertion of the public domain, often called "reclaiming the commons,"[46] involves a direct link between intangible and tangible goods.

For example, the protection of traditional knowledge about genetic resources often requires land reform to permit the custodians of that knowledge to practice the in situ conservation of those resources and biodiversity in general.[47] Yet customary rights to land, and more specifically to the care and use of genetic resources, are often invalidated for lack of formal legal land tenure, particularly if the custodians are women.[48] Where biomass mono-cropping for biofuels conflicts with such customary rights, governments may simply dispossess the custodians, as has occurred in Brazil, where former government officials have been among the recipients of land for soy mono-cropping.[49] In a reformed patent system governed by a human rights framework, governments could deny the use of patented technologies to produce biomass for biofuels on land obtained by violating human rights. As such, there is clearly the need for systemic patent reform that favors the primacy of the public domain in support of human rights. Such reform, e.g. requiring disclosure of genetic resources and traditional knowledge in patent applications, would help prevent patent abuse in biomass for biofuels.

CONCLUSION

Government policies, such as fuel blending mandates, tax credits and subsidies have instigated investment in the biofuels "gold rush" and the push for liberalized global biofuels trade. Though patents did not start this "gold rush," they have and will influence its results. Individual patents, joint ventures formed by patent portfolios and "strategic use" (anticompetitive use) of patents both guide biofuels investment and lock in at least royalties and licensing fees for the patent holder, if not necessarily profits for the biomass or biofuels producers. Hence, understanding patent policy, as well as individual patents on biomass for biofuels production, is crucial for strategizing how the biofuels technologies might aid or hinder sustainable development.

Systemic patent reform is unlikely to occur quickly enough to prevent government and private biofuels investment plans that have damaged natural and human resources, particularly in developing countries, and will cause much greater damage if fully implemented. As outlined above, reckless biofuels investment will likely accelerate climate change, further degrade bio-diversity, dispossess indigenous custodians of their land and genetic resources, reduce land planted to food security crops, and otherwise cause social and environmental havoc. Stopping destructive biofuels investment plans and negotiating tough environmental and social investment performance requirements for biofuels in exchange for use of the public domain is an urgent policy priority at the local, national and multilateral levels.

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