No Free Pass: Putting the "Bio" in Biomass

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In bioenergy policy's early years, the oil shortages of the 1970s in the United States gave rise to laws that incentivized biomass fuel production. This was seen as a sustainable way to reduce dependence on foreign oil and natural gas, as biomass for fuel and power (e.g., corn or wood) can be planted, harvested, and regrown. Although the goal of increasing use of biomass for power remained elusive in the wake of low-priced coal and natural gas, over the next 30 years corn ethanol production came to replace over 10 percent of the U.S. transportation fuel supply. This was so even as prices for imported oil stabilized throughout the 1980s and 1990s because incentives for corn ethanol were seen as a rural economic development tool.

Different bioenergy policies in addition to tax incentives, such as biofuels mandates and renewable portfolio standards (RPSs), emerged in the mid-2000s to address a new global concern beyond energy independence and revival of agricultural communities: the reduction of greenhouse gas (GHG) emissions in order to avert destructive climate change. This decade promises further refinement of what it means for biomass-based energy to be "renewable," "green," "alternative," "advanced," "next generation," or "sustainable." The definitions will encompass issues beyond energy independence, rural development, and GHG reduction. Costly biofuels incentives are fertile ground for those wielding the congressional budget axe in an era of austerity, despite over a decade of massive federal investment in second-generation biofuels to achieve sustainability gains. Cuts may be driven in part by the growing perception that the use of food crops to satisfy biofuels mandates led to the food price spikes of 2008 and may lead to those that threaten in 2011. On another front, environmentalists contend that biomass may actually exacerbate adverse impacts within agricultural and forestry landscapes and communities without formal sustainability controls. Ultimately, therefore, future policies are unlikely to give biomass-based energy a free pass from environmental and socioeconomic scrutiny. This article traces in more detail this evolution of the definition of biomass "sustainability" in law and policy and key issues moving forward for biomass-based energy stakeholders.

The Origins of "Sustainability" Considerations for U.S. Energy Biomass

Congress first promoted renewable fuels on a large scale in response to the Middle-Eastern oil embargos of the 1970s. The Energy Tax Act of 1978 and the Energy Security Act of 1980 incentivized "gasohol" production as a means to achieve energy independence. The later Act aimed to reduce reliance on foreign oil "by all economically and environmentally feasible means, including the use of biomass energy sources." 44 U.S.C § 8801(1). It defined "biomass" broadly as "any organic matter available on a *renewable* basis, including agricultural crops and agricultural wastes and residues, wood and wood wastes and residues, animal wastes, municipal wastes, and aquatic plants." *Id.* (emphasis added). "Environmentally feasible" and "renewable" had no further elaborated meaning, however, other than the listed sources and the general qualifier that responsible agencies had to achieve balance between fuel, food, and fiber production. The Act did disallow any financial assistance for a biomass energy project that did not extract proteins for use for food and feed if such extraction was technically and economically practicable. Otherwise, however, it lacked any mechanism for precisely measuring the effects diverting corn production would have on worldwide food prices. Although the Act placed no environmental conditions on the growing of biomass, which has lead to ecosystem degradation, Congress did have foresight in recognizing the importance of maintaining food security.

By the end of the 1980s, international law began to develop definitions for sustainable development, as awareness of both persistent north-south economic divides and environmental degradation, particularly deforestation, mounted. *Our Common Future* is recognized as the first attempt to formally define "sustainable" development as that which "meets the needs of the present without compromising the ability of future generations to meet their own needs." Our common future: The World Commission on Environment and Development (G. Brundtland, ed., 1987), *available at* www.un-documents.net/wced-ocf.htm.

Concurrently, anthropogenic climate change debuted as one of the greatest sustainability challenges, and international organizations began to mobilize. The World Meteorological Organization and United Nations (UN) founded the Intergovernmental Panel on Climate Change (IPCC) in 1987, and The Montreal Protocol on Substances That Deplete the Ozone Layer issued that same year. In the United States, the 1990 Clean Air Act amendments required, for the first time, GHG inventories and deployment of a strategy to reduce hazardous air pollutants. Two years later, delegates to the Rio Earth Summit agreed to the United Nations Framework Convention on Climate Change (UNFCCC), adding to the United States' obligations to inventory GHG emissions.

Other environmental concerns gained traction in the late 1980s and 1990s in both the forest and agricultural landscapes. Clear-cutting of federal forests in the Pacific Northwest

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triggered highly publicized litigation to protect the northern spotted owl and its habitats under the Endangered Species Act and National Forest Management Act. Environmental litigants were successful in forcing the Forest Service to reassess its statutory obligations, including revision of forest management plans for the protection of endangered species. Distrust within the environmental community continues, however, in light of additional harvesting of forests sanctioned by the 2003 Healthy Forests Restoration Act and the approval of field-testing for genetically modified (GM) trees. This contentious legacy carries over today into the debate between environmentalists and those involved in bioenergy policy. Specifically, groups question whether demand for energy biomass from public lands, which may increase harvests and be sourced from GM trees, will be adequately policed under existing federal laws. The same issues hold true for private forest lands.

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Commodity agriculture experienced similar attempts to reduce its environmental footprint during this time, albeit through proscriptive federal legislation and financial incentives rather than litigation. Stringent protections and measures to prevent conversion of sensitive habitats were authorized in the 1985 Farm Bill, through mandatory requirements to preserve wetlands and highly erodible lands (HEL) (commonly referred to as "Swampbuster" and "Sodbuster," respectively) and programs such as the Conservation Reserve Program. The 1990 Farm Bill made water quality protection in the agricultural context an environmental priority by creating voluntary programs such as the Wetlands Reserve Program and the Water Quality Incentives Program (WQIP). As part of the reorganization of the U.S. Department of Agriculture (USDA) in 1994, and new emphasis on environmental sustainability, the Natural Resources Conservation Service (NRCS) began administering agricultural conservation programs authorized under various farm bills, such as the voluntary Environmental Quality Incentives Program, the Farm and Ranch Lands Protection Program, and the Wildlife Habitat Incentives Program. At the enactment of the 2002 Farm Bill, conservation incentives reached a new height, with the creation of the Conservation Security Program (CSP) and Grassland Reserve Program. *See* The Farm Security and Rural Investment Act of 2002, Pub. L. No. 107-171, 116 Stat. 134. CSP, later renamed the Conservation Stewardship Program, is the first "working lands" conservation program that pays producers to achieve additional environmental benefits. To receive environmental cost-sharing payments, producers must have some form of a NRCS conservation plan. Producers who receive general farm subsidies also must have such plans for HEL. *See* USDA, Econ. Res. Serv., Conservation Policy Background, *available at* www.ers.usda.gov/Briefing/ConservationPolicy/background.htm (last updated Jan. 13, 2009).

Largely absent from consideration in these programs is the relationship between agricultural practices and GHG reduction. And, only in the 2002 Farm Bill did Congress add energy biomass provisions to a Farm Bill, including an expanded definition of "biomass" to include animal, wood and food wastes, and residues. The 2002 Farm Bill did not connect existing and newly created conservation programs with biomass provisions, however, either by giving them special environmental recognition, or attaching any detailed sustainability requirements. This changed with the next Farm Bill in 2008.

Included as part of the 2008 Farm Bill's energy title, the Biomass Crop Assistance Program (BCAP) is the nation's first subsidy program for biomass. BCAP is divided into two parts: (1) a matching payments program for the collection, harvest, storage and transportation of biomass, and (2) establishment and annual payments for perennial (nonfood) crops. The final rule bases payment on whether the material qualifies as "renewable biomass"—a definition limited by land conversion prohibitions and source limitations such as disqualification of Title I crops (e.g., corn). 75 Fed. Reg. 66,202, 66,237 (Oct. 27, 2010). To prevent overharvesting, forest materials sourced both from public or private lands only qualify for BCAP funding if they are "byproducts of preventative treatments" to reduce fire risk, contain disease or insect infestation, or restore ecosystem health. *Id.* at 66,239. In addition, if taken from federal lands, fire reduction techniques must observe the old-growth maintenance, restoration, management, and large tree retention requirements of the Healthy Forests Restoration Act of 2003. BCAP also requires producers to implement a conservation plan for agricultural crops and a stewardship plan for harvesting of forest materials. The rule disallows payments for materials that have higher-value uses, but "higher value" is an economic term of art, not one based on GHG emission reduction or environmental protection.

The proposed BCAP rule hinted at linking matching payments to the amount of GHG reduction achieved by the production of the biomass. This would have been consistent with other bioenergy policies (such as the RFS or RPSs) that require measurements of GHG reduction from biomass refining or combustion. The BCAP final rule discarded the notion of reducing the matching payment based on GHG reduction, however, and instead reduces *annual* payments based on certain end uses. Specifically, based on the percent reduction for each end use, it is clear that the USDA seeks to incentivize cellulosic and advanced biofuels over electricity generation.

But, only one of these end uses—cellulosic biofuels—has a concrete GHG requirement in the final rule. That is, BCAP defines "cellulosic biofuel" through a reference to its definition in the RFS. The RFS requires cellulosic biofuels to achieve a 60 percent GHG reduction over the fossil fuel baseline. BCAP does not reference the RFS in defining advanced biofuels, and instead provides its own definition that does not otherwise reference any percentage GHG reduction.

While federal agricultural, silvicultural, and environmental programs developed generally to enhance environmental values in the agricultural and forest landscape over the last two decades, energy-specific legislation did not necessarily follow this trend. The Energy Policy Act of 1992 reiterated that "alternative" and "replacement" fuels (which it sought to further incentivize) must "yield substantial energy security benefits and substantial environmental benefits," codified at 42 U.S.C. § 13211, but like the 1980 Energy Security Act, did not define specifically the who, what, when, or how. The Biomass Research and Development Act of 2000 created the first interagency research initiative to explore these issues further. Among its tasks was to "ensure that biobased industrial products are developed in a manner that enhances their economic, energy security, and environmental benefits." Pub. L. No. 106-224, 114 Stat. 358. The Act concludes that "many biomass feedstocks . . . show the clear potential for sustainable production, in some cases resulting in improved soil fertility and carbon sequestration." *Id.* § 302. The initiative has aimed to solidify these conclusions regarding the "sustainability" of biomass. However, despite representations since by the Bush administration that "science-based national criteria" would issue (*see* Biomass Research and Development Board, National Biofuels Action Plan 4 (Oct. 2008), *available at* www1.eere.energy.gov/biomass/pdfs/nbap.pdf), none have issued to date.

On the GHG front, the efforts of the Clinton administration in the late 1990s to negotiate binding international commitments failed, and George W. Bush quickly repudiated the Kyoto Protocol in 2001. The United States instead pursued voluntary GHG initiatives and fought legal actions to compel regulation of GHG emissions under the Clean Air Act (CAA). At the same time, Congress established the RFS in the Energy Policy Act of 2005 (EPAct). The EPAct mandated minimum levels of renewable fuel blending in U.S. gasoline supplies and defined "renewable" fuel by delineating its feedstock sources. *See* EPAct of 2005, Pub. L. No. 109-58, 119 Stat. 594, § 1501. The EPAct, like the 1980 Energy Security Act, based its definition of "sustainability" not on practices, but on sources, such as those "produced from grain, starch, oilseeds, vegetable, animal, or fish materials including fats, greases, and oils, sugarcane, sugar beets, sugar components, tobacco, potatoes, or other biomass," as well as cellulosic and "waste-derived ethanol." *Id.* "Waste" included animal, food, and municipal solid wastes. In addition, the EPAct required that for 2013 and beyond, EPA was to set renewable fuel blending amounts based, in part, on the "impact of the use of renewable fuels on the environment, air quality, energy security, job creation, and rural economic development." *Id.*

GHG reduction was not included as part of the initial RFS. Not until the 2007 Energy Independence and Security Act (EISA) increased blending mandates did U.S. policy require that renewable fuels, advanced biofuels, biobased diesel, and cellulosic biofuels achieve percentage GHG reductions over fossil fuel baselines. Unlike any other federal energy or agricultural legislation both then and now, EISA's RFS also dictates that indirect land-use change (ILUC) be part of EPA's GHG accounting. ILUC is the controversial penalty assigned to fuels based on the GHG emissions from land conversion induced in other countries (particularly deforestation for agricultural cropping) due to the rise in demand (and price) for agricultural commodities resulting from renewable fuel mandates. To curtail GHG releases from both ILUC and direct land-use change, and out of concerns for food security, Congress capped the amount of corn-based renewable fuel at 15 billion gallons. In addition, EISA contains a land conversion restriction as of the date of enactment, places sourcing from federal lands off-limits, and requires EPA to report on the sustainability effects of the RFS. EPA also has the authority to adjust the mandate in light of food price effects.

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The Supreme Court's pivotal decision in *Massachusetts v. EPA*, 549 U.S. 497 (2007) ended the Bush administration's contention that EPA could not (and should not) regulate GHG emissions under the CAA. The 2008 presidential election ushered in a sea-change of GHG regulation of mobile and stationary sources with the EPA issuing its Endangerment and Cause or Contribute findings required by the CAA for GHG regulation. 74 Fed. Reg. 66,496–66,546 (Dec. 15, 2009). As the Obama administration attempts to fill remaining voids in federal GHG policy through regulation, California continues to pursue a suite of aggressive policies, introduced throughout the 2000s, to reduce GHG emissions, such as a low-carbon fuel standard, renewable portfolio standard, cap-and-trade regulation, and coordinated investment strategies. Other states have followed suit. Many of these policies require use of "renewable"

or "sustainable" biomass, although definitions of these terms differ between states, raising further issues regarding the impact of these differences on interstate commerce in energy biomass.

Key Issues on the Horizon

Biomass feedstocks increasingly are coming under direct scrutiny for their environmental, social, and economic impacts, although, historically, commodity agriculture largely has been exempt from environmental rules or enforcement. For example, concerns have surfaced that increased demand for biomass driven by GHG or renewable fuel policies, without sufficient safeguards, will incentivize overharvest of forests and conversion of ecologically sensitive lands. In addition to significant GHG releases, careless practices can threaten biodiversity and diminish water and soil quality. Controversies over invasive species also loom on the horizon, as litigation challenging the release of genetically engineered commodity food and feed crops without sufficient environmental review threatens to spill over to newly developed biomass varieties.

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In addition to environmental protection, attention to socio-economic sustainability has grown in recent years parallel with the development of bioenergy policies. The "food versus fuel" moniker that emerged from the price spikes of 2008 almost certainly will linger to the extent biomass appears to compete for land with food cropping. Land grabs in developing and underdeveloped countries may harm indigenous peoples or subsistence farmers who do not have a formal delineation of property rights. The shuttering of midwestern ethanol plants in the late 2000s dealt blows to rural economic development initiatives, while adding to critics' claims that rural prosperity should not depend heavily on chemical inputs that degrade soil and water quality and create expanses of uniform landscapes lacking vital habitat dynamics. In addition, a growing world population hungry for western lifestyles undoubtedly will heighten debate over how to meet human needs while protecting fragile ecosystems and improving already degraded ecosystems.

Still, second-generation agricultural biomass cropping has great possibility to provide high-yielding energy feedstocks with fewer inputs and smaller GHG footprints, while at the same time improving water quality and wildlife habitat. Debates surrounding forest biomass have stimulated research to more accurately measure forests' sequestration capabilities. As governments reconsider land-use policies in an attempt to better balance humankind's social and economic needs with those of natural systems, the refinement of the definition of "sustainable" renewable energy will structure development of the biomass sector.

GHGs

The potential for GHG reduction, if any, is front and center in the biomass policy debates, particularly with regard to development and application of GHG accounting methodologies for biomass-based feedstocks. Inconsistencies exist between federal GHG policies, federal and state policies, and between states or regional GHG reduction efforts, such as the Regional Greenhouse Gas Initiative. One key issue is whether biomass should be treated as carbon neutral. For example, the RFS does not assume overall carbon neutrality and instead requires EPA lifecycle analysis to include ILUC. Even with ILUC included, however, results have been carbon negative. This net negative carbon result was challenged, however, on several grounds. First, the theory of "global rebound effect" argues that increased blending of alternative fuels lowers the demand for fossil fuels, causing their price to decline, which increases their consumption in other jurisdictions that do not have mandates or low-carbon fuel standards, and with the result that GHG emissions show a net increase. *See* Clean Air Task Force (CATF), Petition for Reconsideration of the Final Rule on the Regulation of Fuels and Fuel Additives: Changes to Renewable Fuel Standard Program (May 21, 2010), *available at* www.catf.us/resources/filings/biofuels/20100521-CATF_Petition_for_Reconsideration_of_RFS2.pdf. EPA denied that petition in late February 2011 and the CATF has filed a petition for review. Petitioners also have argued that EPA incorrectly calculated emissions from the domestic forest industry, and that it erred in its assumptions about future yield rates and co-product utilization. *See Friends of the Earth, Inc. v. EPA*, 10-cv-1108 (D.C. Cir. 2006).

On the other hand, EPA assumes carbon neutrality for purposes of its inventory obligations under the UNFCCC, a treaty that does not require an ILUC calculation. The Center for Biological Diversity has formally requested that EPA correct its inventory for 1990–2008, arguing that under the 2001 Data Quality Act, EPA has not met its obligation to apply accurate and reliable accounting methodologies and that, among other remedies, it must "abandon" carbon neutrality. *See* www.biologicaldiversity.org/programs/climate_law_institute/global_warming_litigation/pdfs/CBD_DQA_Petition_072810.pdf.

EPA applies yet another methodology in the Mandatory GHG Reporting Rule, established as part of a 2008 appropriations bill and finalized with regard to biomass in 2010. Previously only coal-fired power plants were required to report under the CAA. Under the new rule, biomass emissions must be inventoried, but they do not count toward the threshold that triggers

reporting. Perhaps the most intriguing development, however, has been EPA's position on biomass neutrality in the GHG Tailoring Rule. In its Final Rule, issued in May 2010, EPA did not grant a permanent exclusion based on the theory of carbon neutrality. It did, however, indicate that it would explore the issue further in future rulemaking. Then, in July 2010, EPA issued a Call for Information seeking comments on GHG accounting methodologies for biomass. In a surprising turn, EPA did not issue anything further with regard to the Call. Instead, in January 2011, it granted the National Alliance of Forest Owners petition for reconsideration of the Tailoring Rule with regard to biogenic emissions and deferred by three years GHG permitting of CO_2 emissions from biomass (although not stated, presumably EPA means CO_2 equivalent (CO_2e), as GHGs other than CO_2 such as nitrous oxide are regulated through CO_2e in the Tailoring Rule). EPA explains that the delay is needed in order to "effectuate a detailed examination of the science associated with biogenic $C0_2$ emissions and to consider the technical issues that the agency must resolve in order to account for biogenic $C0_2$ emissions in ways that are scientifically sound and also manageable in practice." EPA letter (Jan. 12, 2011), *available at* www.epa.gov/NSR/ghgdocs/McCarthytoMartella.pdf. EPA has indicated in permitting guidance issued in November 2010 that permit authorities, in determining the best available control technology (BACT), can consider "both existing federal and state policies and their underlying objectives in evaluating the environmental, energy and economic benefits of biomass fuel." EPA, PSD, and Title V Permitting Guidance for Greenhouse Gases 9, *available at* www.epa.gov/nsr/ghgdocs/epa-hq-oar-2010-0841-0001.pdf. BACT determinations, therefore, may provide the first look at how EPA intends to balance all of the elements of sustainability. It will be particularly interesting to see how EPA reconciles minimum co-firing requirements in state renewable portfolio standards with GHG and other pollution-control concerns.

As with the federal system of GHG regulation of energy biomass, California applies inconsistent GHG accounting. Unlike the ILUC penalty applied pursuant to its Low-Carbon Fuel Standard, its recently proposed regulations for the cap-and-trade program require reporting but no compliance obligation for biomass-derived emissions entities that otherwise must report under the California Mandatory GHG Emissions Reporting Rule. Under cap and trade, only stack emissions are measured, with no consideration of the potential ILUC caused by the increased demand for biomass feedstocks for power generation.

Other countries are grappling with whether and how to apply ILUC to biofuels policies. For example, the European Union (EU) in December 2010 delayed a decision on how it will account for ILUC in lifecycle emission calculations for GHGs under its Renewable Energy Directive (RED).

"Other" Sustainability

Bioenergy laws and several voluntary standard initiatives for biomass are designing ways to address the "other" environmental and socioeconomic aspects of increased biomass production. Section 204 of EISA contains a requirement that EPA report at the end of 2010, and periodically thereafter, on the environmental impacts of the RFS, including hypoxia and pesticide use, and other water- and soil-quality parameters. EPA's focus likely will be on corn ethanol, as it has been the primary source to date of RFS-qualified fuels. Friends of the Earth has challenged EPA's failure to exercise its authority under CAA § 211(c)(1) to "control or prohibit" the introduction of alternative fuels that "cause or contribute" to water pollution. *Friends of the Earth, Inc. v. EPA*, 10-cv-1108 (D.C. Cir. 2006)

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USDA currently is in the process of developing conservation planning for BCAP-subsidized biomass but concedes that biomass-specific practices remain underdeveloped. 75 Fed. Reg. 66,202, 66,228 (Oct. 27, 2010). The Conservation Effects Assessment Project (CEAP) began in 2003 to explore the possible disconnect between NRCS conservation planning and practice standards and ecosystem level results. BCAP also requires forest stewardship planning for subsidies to forest-based biomass. It remains uncertain if stewardship planning and practices will need to be adjusted to account for increased demand in existing forests and introduction of trees genetically engineered for biomass production. Questions remain as to whether existing forest-protection laws, ranging from the Forest Practices Act in California to the federal Healthy Forests Restoration Act, provide adequate safeguards against overharvesting for energy biomass.

EPA's July 2010 Call for Information for the GHG Tailoring Rule also asked, in addition to GHG accounting methodologies, whether "other" biomass sustainability factors should be considered in permitting decisions. EPA emphasized sustainability issues with regard to forest biomass. Although EPA has now delayed GHG accounting methodologies for three years, it remains unclear whether it will also delay consideration of rules addressing other aspects of forest protection that it highlighted in the Call for Information.

States also are grappling with forest sustainability issues as they implement their bioenergy policies. In at least one

state—North Carolina—environmental groups are appealing the Utilities Commission's November decision allowing Duke Energy to generate renewable energy credits through the unrestricted harvest and combustion of whole trees. In addition, both California and the EU are pursuing sustainability standards to accompany their GHG reduction programs, for both agricultural landscapes and forests. These varying biomass sustainability standards will ultimately lead to the question of how international trade rules apply. Brazil has alluded to a challenge to the EU RED's sustainability provisions.

In both the European Union and United States, how biofuels policies and standards define "degraded," "marginal," "abandoned," and "idle" land will be pivotal to the food versus fuel question (as well as protection of biodiversity).

At the same time, many voluntary efforts are afoot to set sustainability standards for energy biomass feedstocks. In the United States, the Council for Sustainable Biomass Production (CSBP) is field-testing a provisional standard that contains principles governing air, water, and soil quality, GHG emissions, biodiversity, land conversion, and socioeconomic considerations, such as respect for labor laws. CSBP recently undertook development of the first standard in the United States for short-rotation woody biomass. Similar voluntary standards for energy biomass are in development in Europe and Brazil and at the international level.

Dire predictions of food price spikes, like those of 2008, recently have begun to resurface. Policymakers must continue to hone mechanisms to measure and mitigate any adverse impacts biomass cropping may have on food prices, while at the same time addressing GHG impacts from direct and indirect land conversion. Land conversion proscriptions do protect habitats and guard against direct GHG releases but also constrain land availability for biomass production by disallowing harvests from lands converted after certain dates. This forces biomass to either compete with food cropping for existing acreage or drives food cropping onto virgin lands. The RFS, BCAP, and EU RED do not prohibit conversion of virgin lands for food cropping, although there is a default ILUC penalty on biomass. While from a food production perspective this may be good policy, land conversion results in destruction of habitat. EPA's aggregate compliance rule for measuring land conversion resulting from RFS mandates has been challenged, in part, because environmentalists fear that the method cannot adequately measure the overall level of land conversion.

Although EISA authorizes EPA to adjust RFS blending requirements to mitigate food price impacts, it is uncertain what methodologies EPA would use to make this determination. For example, the EU RED requires periodic reporting on food price impacts, encourages member states to develop policies that incentivize nonfood and waste feedstocks, and provides a GHG "bonus" for crops grown on "degraded" land. In both the EU and United States, how biofuels policies and standards define "degraded," "marginal," "abandoned," and "idle" land will be pivotal to the food versus fuel question (as well as protection of biodiversity), but U.S. efforts in this regard remain in their infancy or are nonexistent. In 2010, the Food and Agriculture Organization of the United Nations devised an analytical framework through which to consider food-security questions within the context of bioenergy production and is in the process of developing assessment criteria and indicators that may be helpful in disarming speculative claims against biofuels.

Conclusion

As demonstrated by these emerging sustainability considerations, the debate over whether, or to what degree, energy biomass can be considered renewable or sustainable likely will not subside, even in a depressed economic climate and despite the nascent nature of the industry. Standards are emerging to address both GHG and other sustainability issues, such as water quality and quantity, biodiversity, land conversion, soil quality, and social protections. *See* Jinke Van Dam, Update: Initiatives in the Field of Biomass and Bioenergy Certification (Apr. 2010), *available at* www.bioenergytrade.org/downloads/overviewcertificationsystemsfinalapril2010.pdf. Whether government-sponsored or private in nature, any sustainability standard for energy biomass relies critically upon scientific research to gauge achievements. Such research is in its embryonic stages. While governments, universities, and industry are investing heavily in research on practice standards and outcomes, measuring the costs, benefits, and barriers to achieving and enforcing different levels of sustainability will be critical to development of the biomass sector. An analysis of governance principles within nonstate, market-driven initiatives is critical to determine whether sustainability is more than merely greenwashing. With the introduction of carbon-trading regimes, the possibility of similar ecosystem marketplaces, and increased government incentives for biomass production and consumption, producers who embrace biomass sustainability standards could actually reap economic opportunities as early movers. Lastly, the acceleration of biomass-based energy incentives in the past few years, coupled with sustainability debates, may spur a new sustainability paradigm within all agricultural and forest landscapes.

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