AGRICULTURE AT A CROSSROADS: ENERGY BIOMASS STANDARDS AND A NEW SUSTAINABILITY PARADIGM?

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Abstract

Bioenergy policy through the past decade increasingly has emphasized combustion and conversion of biomass as a means to combat greenhouse gas emissions, ease dependence on foreign energy sources, and create jobs in rural areas. As demand for biomass increases due to laws such as the Energy Independence and Security Act and the Biomass Crop Assistance Program (BCAP), questions have arisen as to how "green" biomass cropping really can be if production merely follows an agricultural status quo that has arguably lead to environmental problems such as Gulf hypoxia, widespread monocultures with little species diversity, and decreased water quality and quantity. Further, if new biomass cropping replaces food production on the same number of acres, food security issues arise due to increases in commodity prices. If expanded to new lands, native habitats may be destroyed. To address these concerns, many sustainability standards recently have emerged, or are likely to issue in the near future. For example, USDA has issued regulations that require conservation planning in order to receive a BCAP subsidy. California is in the process of developing sustainability standards for biomass used in transportation fuels as well as the generation of electricity. The Council for Sustainable Biomass Production has issued a provisional voluntary standard for the U.S. market. And, EPA must report to Congress in 2010 on the environmental ramifications of the renewable fuels mandate.

In addition to achieving consistency among biomass sustainability standards, a main challenge moving forward is ensuring credibility and ease of implementation. Existing agricultural conservation programs in the U.S. contain planning and assessment protocols, practice-based modeling, and program evaluation procedures that can inform greatly efforts to consistently define "renewability" in biomass-specific mandates and subsidy programs. Government agencies, the scientific community, and stakeholders in the process must, however, strengthen their collaborative efforts so that biomass' potential to significantly improve the agro-environmental landscape through standards is better understood. Most significantly, a rethink of existing agricultural conservation programs in the energy biomass context has the real potential to create an entirely new sustainability paradigm for the entire agricultural sector.

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> . . .stewardship is about being responsible. It is about changing attitudes, forging local shared visions of the desired state for private and public natural resources, and facilitating the actions needed to realize the desired future condition. Institutionally, stewardship is about assisting land users to care for the resources.
>
> -*National Resource Conservation Service National Planning Procedures Handbook*[1]

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[1] *See infra* note 118.

I. Introduction

Opposition to biomass'[2] label as "sustainable" or "renewable" is generally three-fold.[3] The criticism that has received the most attention from policymakers and the press by far has been the indirect land use change implications of energy biomass demand (i.e., increased carbon emissions resulting from deforestation for cropland).[4] A close second is the claim by scientists, non-governmental organizations (NGOs), and the food industry, among others, that the amount of energy biomass feedstocks needed to satisfy bioenergy mandates will result in competition for acreage with food production, and lead to higher food prices and even food shortages for the world's poorest peoples.[5] Therefore, from a socio-economic sustainability point of view therefore, energy biomass production is ethically unacceptable. The third factor–and central focus of this article–is that without some type of field-level sustainability standards, energy biomass grown under industrialized conditions, heavily dependent on fossil fuel inputs and irrigation, merely solidifies an unsustainable status quo within commodity agriculture unbefitting of a "bio" fuel, even if GHG emissions are otherwise reduced.[6]

Acknowledging that the U.S. is not on a trajectory to meet ambitious renewable fuel blending requirements, the Obama Administration announced on February 3, 2010 a new, integrated approach.[7] Conspicuous in the new strategy was an emphasis on conducting an "up-front" assessment of sustainability in biomass feedstock production systems.[8] This new approach presumably will address the Renewable Fuels Standard (RFS2) and the Biomass Crop Assistance Program (BCAP), which contain somewhat different definitions of "renewable biomass," as well as the Administration's new greenhouse gas (GHG) emission rules for mobile

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[2] Generally, "the term biomass can refer to any source of heat energy produced from non-fossil biological materials," ranging from "firewood to ethanol produced from corn or sugarcane to methane captured from landfills." Christopher B. Field, *et al.*, *Biomass energy: the scale of the potential resource*, 23 TRENDS IN ECOL. & EVOLUTION 65 (Feb. 2008). Biomass currently constitutes approximately 7% of the world's energy supply. *Id.*

[3] *See* Tilman, *et al.*, *Beneficial Biofuels—The Food, Energy, and Environment Trilemma*, 325 SCIENCE 270 (July 2009).

[4] For the seminal article in this regard, *see* Timothy Searchinger, *et al.*, *Use of U.S. Croplands for Biofuels Increases Greenhouse Gases Through Emissions from Land-Use Change*, 319 SCIENCE 1238 (Feb. 29, 2008).

[5] *See e.g.*, Jacinto F. Fabiosa, *et al.*, *The Global Bioenergy Expansion: How Large are the Food-Fuel Tradeoffs?* In Khanna, *et al.*, HANDBOOK OF BIOENERGY ECONOMICS AND POLICY (Springer 2010); C. Ford Runge & Benjamin Senauer, *How Biofuels Could Starve the Poor*, 86 FOREIGN AFFAIRS 41 (May/Jun. 2007); ActionAid, *Meals per gallon: The impact of industrial biofuels on people and global hunger* (Feb. 2010), *available at* http://www.actionaid.org.uk/doc_lib/meals_per_gallon_final.pdf; *Food-related industries launch anti-biofuel campaign*, BLOOMBERG NEWS (Jun. 10, 2008), *available at* http://www.chron.com/disp/story.mpl/headline/biz/5829126.html.

[6] Agriculture has historically remained exempt from environmental regulation, causing well-documented environmental problems in the landscape. *See generally* Mary Jane Angelo, *Corn, Carbon, and Conservation: Rethinking U.S. Agricultural Policy In a Changing Global Environment*, 17 GEO. MASON L. REV. 593, 613-621 (Spring 2010); Nicolai V. Kuminoff, *Public Policy Solutions to Environmental Externalities from Agriculture*, Amer. Enterprise Inst. Policy Series, 7-10 (2007), http://aic.ucdavis.edu/research/farmbill07/aeibriefs/20070515_kuminofffinal.pdf; Michael Jahi Chappell and Liliana A. La Valle, *Food Security and biodiversity: can we have both?* J. AGRIC. & HUMAN VALUES at 7 (Nov. 27, 2009) (detailing the state of industrialized and alternative agriculture).

[7] White House, *Growing America's Fuel: An Innovation Approach to Achieving the President's Biofuels Target* (Feb. 3, 2010) [hereinafter Growing America's Fuel], available at http://www.whitehouse.gov/sites/default/files/rss_viewer/growing_americas_fuels.PDF.

[8] *Id.*

and stationary sources that likely will lead to increased consumption of biomass.[9] In addition to federal level efforts, California is aggressively developing policies in both its transportation and electricity sectors that recognize that sustainability of feedstocks must be considered concurrently with GHG reduction measures. In anticipation of compliance requirements, the Council for Sustainable Biomass Production (CSBP), a private stakeholder effort to develop biomass sustainability standards in the U.S., has issued a provisional standard and is currently in the process of developing criteria and indicators through field-testing.

The challenge moving forward for policymakers and standard setters will be to design sustainability regimes that affect positive change, while at the same time fostering timely development of the energy biomass sector. From a scientific perspective, important issues regarding the "renewability" or "sustainability" of energy biomass cropping practices remain outstanding.[10] While scientific research continues to close knowledge gaps, existing government agro-environmental programs may be the logical first choice for policymakers to look to for guidance. Indeed, the newly finalized BCAP regulation defines "renewability" as having a conservation plan in place approved by USDA's Conservation Credit Corporation (CCC).[11] USDA's Natural Resources Conservation Service (NRCS), in cooperation with state and local conservation authorities, is mainly responsible for administering sustainability considerations embedded in other federal subsidy programs for both agricultural commodity production and land retirement, such as the Conservation Security Program (CSP) and the Conservation Reserve Program (CRP). Its experience, therefore, could be a platform on which to build biomass sustainability practice standards. On the flip-side, the emerging bioenergy economy and the process of defining what "renewable" energy really means has real potential to shift the sustainability paradigm within all of commodity agriculture through reconsideration of the overall effectiveness of policies and conservation practice standards like those of the NRCS.

The goal of this Article is to examine existing U.S. agricultural conservation policies in light of emerging bioenergy policies and standards, and whether they can serve as a framework for establishing sustainable agronomic practices for energy biomass. Although energy biomass includes both agricultural cropland and forest material, the article focuses on arguably the more underdeveloped agricultural sustainability practices for crop production, and saves an analysis of forest energy biomass standards for another day.[12] The Introduction sets the stage by providing a

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[9] U.S. EPA, *Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule*, INSERT FED REG CITE when it issues (May 10, 2010), codified at 40 C.F.R. Parts 51, 52, 70, & 71; U.S. EPA and U.S. Dept. of Transportation, *Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards: Final Rule*, 75 Fed. Reg. 25324-25728 (May 7, 2010), codified at 40 C.F.R. Parts 85, 86 & 600; 49 C.F.R. Parts 531, 533 536 *et seq.*

[10] Veronica Domburg, *et al.*, BIOMASS ASSESSMENT: ASSESSMENT OF GLOBAL BIOMASS POTENTIALS AND THEIR LINKS TO FOOD, WATER, BIODIVERSITY, ENERGY DEMAND AND ECONOMY 20 (Netherlands Research Program on Scientific Assessment and Policy Analysis for Climate Change (WAB), Jan. 2008), *available at* http://www.rivm.nl/bibliotheek/rapporten/500102012.pdf; *See* Adrian Muller, *Sustainable agriculture and the production of biomass for energy use*, 94 CLIMATIC CHANGE 319, 322(2008) (concluding that "[o]ther than land competition. . . [the] environmental sustainability of large-scale bioenergy production has not yet entered the broader discussion . . .")

[11] *See infra* Part X.

[12] While organic farming standards for food and livestock have been in operation for almost ten years, no comprehensive government or private sustainability regime for biomass cropping is yet in place in the U.S. Scientific Certification Systems (SCS), through the Leonardo Academy, is in the process of developing an American National Standards Institute (ANSI) standard for food crops, but it is unclear whether the standard will develop biomass-specific metrics. *See* Leonardo Academy, Sustainable Agriculture Standard (SCS-001) Development, available at http://www.leonardoacademy.org/programs/standards/agstandard/development.html.

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brief overview of bioenergy legislation in the U.S. and its current and future sustainability requirements beyond GHG reduction, general sustainability principles, and the voluntary CSBP provisional sustainability standard for energy biomass. Part III examines in detail NRCS conservation planning processes, measurement tools, and recommended practices. Part IV takes a look at government agricultural sustainability programs that historically have been designed for commodity food production, but could be used as scoring tools to evaluate project proposals in the biomass feedstock context. Drawing on prior sections, the conclusion makes policy design recommendations moving forward to achieve optimal sustainability, while at the same time avoiding costly and time-consuming duplication that could hinder progress toward a biomass-based energy future.

II. The Evolution of Biomass Sustainability Requirements

The term "renewable energy," in its most basic form, means energy that is "continually available so some degree or other all over the world."[13] Like the sun that shines, the wind that blows, or rivers that flow, plants can regenerate and are thus arguably "renewable." But also like solar panels that use water, wind turbines that kill bats, or dams that impede salmon, energy biomass has its own set of environmental trade-offs. Conventional agricultural practices maintain soil nutrients and achieve ever-increasing yields through fossil fuel inputs, genetically modified plants, and vast stretches of monocultures that contribute to, or have an unknown potential to cause, environmental degradation. Further, weeds and insects are suppressed through pesticides and herbicides. Some question whether such a system truly is "sustainable."

The ultimate definition of what a sustainable agricultural system should look like varies.[14] One of the most commonly cited definitions of sustainability is "to supply a growing population with [X commodity, be it food or energy] without destroying the environment within which it is [derived] and used, providing [said commodity] for the present without compromising the ability of future generations to meet their needs."[15] Others are more human-centric, defining agricultural "sustainability" as "an agriculture that can evolve indefinitely toward greater human utility, greater efficiency or resource use, and a balance with the environment that is favorable both to human and to most other species."[16] Standards also are increasingly extending the

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On the other hand, private forest sustainability certification schemes have existed in the U.S. since 1992, including the Forest Stewardship Council (FSC), Sustainable Forestry Initiative (SFI), American Tree Farm System (ATFS), and the Program for the Endorsement of Forest Certification (PEFC). *See* CSBP Draft Standard, *infra* note X, at 7.

[13] American Council of Renewable Energy, *What is Renewable Energy*, available at http://www.acore.org/what_is_renewable_energy.

[14] *See generally* Xun Jin & Karen A. High, *A New Conceptual Hierarchy for Identifying Environmental Sustainability Metrics*, 23 ENVTL. PROGRESS 292, 292 (Dec. 2004) (concluding that despite "[a] vast diversity in defining sustainability . . . during the later half of the past century. . . various explanations [of the meaning of sustainability] can be essentially sorted into three classes of views" (inter-/intra-generation equity, the critical limits view, and the competing objectives view)).

[15] John A. Turner, *A Realizable Renewable Energy Future*, 285 SCIENCE 687 (July 1999) (citing THE WORLD COMMISSION ON ENVIRONMENT AND DEVELOPMENT, OUR COMMON FUTURE (The Bruntland Report) (Oxford Univ. Press, NY 1987)).

[16] Richard R. Harwood, *in* CLIVE A. EDWARDS, *et al.*, eds., SUSTAINABLE AGRICULTURAL SYSTEMS (The Soil and Water Conserv. Society 1990) (detailing the historical evolution of the concept of sustainability in agriculture).

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meaning of "sustainability" to include sustainable social practices such as fair labor standards and benefits to the greater community such as education and health care.[17]

How to achieve this sustainability in agriculture "remains elusive."[18] Within the abundant scientific scholarship addressing the nexus generally between agricultural production and environmental quality, conflicting views emerge on future courses of action. Some scholarship suggests that a range of "alternative" agricultural practices (e.g., closed-loop plant nutrient systems, no-till/conservation agriculture, integrated pest management) can provide enough food globally, increase profits for small farmers, and achieve a higher level of environmental quality.[19] Others conclude that widespread adoption of alternative practices increases costs and decreases yield, and advocate instead for yield increases through genetic modification that would allow for biomass and food production on the same or less number of acres.[20] Opponents counter that increasing yields per acre through GM crops may actually lead to more deforestation "due to the fundamental economic pressure to take advantage of successful high-yielding practices," particularly if population growth sustains demand for food.[21] Instead, they contend that systems that increase productivity per acre but require more labor avoid deforestation for biomass cropping (and thus increased GHG emissions), save more land for biodiversity, increase rural employment, and provide food security worldwide from the same number of acres.[22]

As consensus grows that climate change and reliance on imported fuels pose significant environmental and energy security risks for the U.S., so will inertia toward renewable energy substitutes including biomass-based fuels. At the same time, consumer sentiment has grown toward a "closer connection between people and the food they eat," a connection that admittedly has become lost as agricultural industrialized over the past 50 years.[23] This stems from the belief that economies of scale in the food production sector in the U.S. have provided uniformity and lower cost agricultural raw materials, but not without costs to rural society,[24] human health, food security,[25] and the natural environment. In light of these consumer trends, society must now grapple with the meaning of "renewable" fuel. Thus far, it has primarily been based on energy

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[17] Although important, the Article's focus, however, will be limited to the environmental sustainability of biomass' *agronomic* practices.

[18] *See generally* D. Rigby and D. Cáceres, *Organic farming and the sustainability of agricultural systems*, 68 AGRIC. SYS. 21 (2001); Michelle Wander, in PATRICK J. BOHLEN AND GAR HOUSE eds., SUSTAINABLE AGROECOSYSTEM MANAGEMENT: INTEGRATING ECOLOGY, ECONOMICS, AND SOCIETY 159 (CRC Press 2009) (stating that "[p]ressures on the land and growing acceptance of resource limits are rekindling interest in [plant productivity and nutrient use efficiency]").

[19] Chappell *et al.*, *supra* note 6, at 9; 12.

[20] *See* Muller, *supra* note 10 (noting that "[t]here is an ongoing debate on yields in sustainable agriculture," and providing a literature review on both sides of the issue).

[21] Chappell, *et al.*, *supra* note 6, at 4, 8.

[22] *Id.* Chappell *et al.* suggest that food insecurity is "a matter not of total availability but indeed one of access, political power, and equity." *Id.* at 6.

[23] *See* Susan A. Schneider, *Reconnecting Consumers and Producers: On the Path Toward a Sustainable Food and Agriculture Policy*, 14 DRAKE J. AGRIC. L. 75, 76 (2009) (citing Neil Hamilton, *Food Democracy and the Future of American Values*, 9 Drake J. Agric. L. 9 (2004)).

[24] Janel M. Curry, *Care Theory and "caring" systems of agriculture*, 19 J. AGRIC. & HUMAN VALUES 119, 122 (2002) (noting that today's status quo, stemming from structural changes in US agriculture over the past 100 years, has emphasized individual farm profitability and left out entirely the connection of the individual farming operation to the community and nature).

[25] *See e.g.*, A. Bryan Endres and Jody M. Endres, *Homeland Security Planning: What Victory Gardens and Fidel Castro Can Teach Us in Preparing for Food Crises in the United States*, 64 Food & Drug L.J. 405 (2009).

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security, rural development and perhaps reduction of GHGs, while maintaining the status quo of industrialized agricultural production practices. Increasing environmental awareness as well as the human need for both food and energy, however, may necessitate a more holistic, multi-functional system–a sustainable system–for all agricultural production.[26]

A. The Definition of "Renewable Biomass" In U.S. Bioenergy Policies

Historically, U.S. biofuels policy has relied primarily on corn as an ethanol feedstock. Although corn ethanol has served as an engine for rural development, the environmental implications of conventional corn production[27] went largely unaddressed in government energy policy until enactment of the Energy Independence and Security Act of 2007 (EISA).[28] In order to satisfy the mandatory blending levels of "renewable fuels" into transportation fuels, all biofuels qualifying for EISA's renewable fuel standard (RFS) must for the first time achieve a certain level of GHG reductions and be derived from "renewable biomass."[29] In addition, the 2008 Farm Bill established the first supply-side incentive for renewable biomass through creation of the Biomass Crop Assistance Program (BCAP).[30] Implementing regulations for BCAP condition payment on whether the biomass was produced under a conservation plan. At the state-level, California is in the process of developing biomass sustainability standards to accompany its broader GHG reduction agenda embedded in programs such as the Low Carbon Fuel Standard (LCFS).

1. The Renewable Fuel Standard (RFS2)

EISA mandates increasing amounts of cellulosic biofuels, biomass-based diesel, advanced biofuels, and "renewable" fuels in the fuel supply through 2022.[31] In addition to mandatory GHG emission thresholds for each category of fuel,[32] obligated parties under RFS2 must source renewable fuels from "renewable biomass."[33] "Renewability" in the statute focuses

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[26] One scholar asserts that there currently is no "forum for consideration of ethical issues in food" and suggests a more holistic approach in the future. Susan Schneider, *A Reconsideration of Agricultural Law: A Call for the Law of Food, Farming, and Sustainability*, 34 WM. & MARY ENVTL. L. & POL. REV., XXX (2009); Daniel Hillel and Cynthia Rosenzweig, in BOHLEN & HOUSE, *supra* note 18, at 188 (concluding that ([a] more holistic approach to the integration of farming and ecology will better promote nutrient recycling, biological pest and disease control, pollination, soil quality maintenance, water-use efficiency, and carbon sequestration").

[27] A primary concern is nitrogen loading in the Mississippi River system, which scientists claim causes ecological dead zones in the Gulf of Mexico. *See generally* C. Costello *et al.*, *Impact of biofuel crop production on the formation of hypoxia in the Gulf of Mexico*, 43 ENVIR. SCI. TECHNOL. 43 (20), 7985–7991; S.D. Donner and C.J. Kucharik, *Corn-based ethanol production compromises goal of reducing nitrogen export by the Mississippi River*, 105 PNAS 4513–4518 (2008); Virginia H. Dale, *et al.*, *Biofuels: Implications for Land Use and Biodiversity*, ECOLOGICAL SOCIETY OF AMERICA 9 (Jan. 2010) (stating that local farm choices with regard to fertilizer use have "broad implications" including dead zones in the Gulf of Mexico).

[28] Pub. L. No. 110-40, 121 Stat. 1492-1801 (2007) [hereinafter EISA].

[29] *Id.* § 201 (codified at 42 U.S.C. § 7545(o)).

[30] The Food, Conservation, and Energy Act of 2008, Pub. L. No.110-246, § 9001, 121 Stat. 1768 (2008) (codified at 16 U.S.C. 8111) [hereinafter 2008 Farm Bill].

[31] EISA, *supra* note 28, at § 202 (a)(2) (codified at 42 U.S.C. § 7545(o)(2)(B))

[32] *Id.* § 201 (definitions) (codified at 42 U.S.C. § 7545(o)(1)(B), (D), (E), (J)).

[33] *Id.* § 201 (definitions) (codified at 42 U.S.C. § 7545(o)(1)(I)). Renewable biomass includes:

on land conversion prohibitions,[34] limits on biomass sourcing non-federal forests, and absolute bars against harvests from old growth or late succession forests and forests with ecological communities with a certain global or state ranking.[35] No equivalent provisions apply to agricultural lands. In March 2010, EPA finalized implementing regulations for EISA.[36] EPA is taking an "aggregate compliance approach" to enforcing the land-use provisions.[37] That is, producers will not be required to retain any records of compliance unless the "2007 Baseline" amount of agricultural land has been exceeded.[38] If exceeded, the domestic obligated party can show evidence of compliance by participation in a farm program or a written management plan.[39]

The environmental effects of biomass cropping beyond just land-use change are at least on Congress' radar, however. The EPA Administrator, in consultation with the Secretary of Energy, must "assess and report to Congress on the [current and future] impacts of [the RFS] on. . . :

> (1) Environmental issues, including air quality, effects on hypoxia, pesticides, sediment, nutrient and pathogen levels in waters, acreage and function of waters, and soil environmental quality.
> (2) Resource Conservation issues, including soil conservation, water availability, and ecosystem health and biodiversity, including impacts on forests, grasslands and wetlands.

> (i) Planted crops and crop residue harvested from agricultural land cleared or cultivated at any time prior to the enactment of this sentence that is either actively managed or fallow, and nonforested.
> (ii) Planted trees and tree residue from actively managed tree plantations on non-federal land cleared at any time prior to enactment of this sentence, including land belonging to an Indian tribe or an Indian individual, that is held in trust by the United States or subject to a restriction against alienation imposed by the United States.
> (iii) Animal waste material and animal byproducts.
> (iv) Slash and pre-commercial thinnings that are from non-federal forestlands, including forestlands belonging to an Indian tribe or an Indian individual, that are held in trust by the United States or subject to a restriction against alienation imposed by the United States, but not forests or forestlands that are ecological communities with a global or State ranking of critically imperiled, imperiled, or rare pursuant to a State Natural Heritage Program, old growth forest, or late successional forest.
> (v) Biomass obtained from the immediate vicinity of buildings and other areas regularly occupied by people, or of public infrastructure, at risk from wildfire;
> (vi) Algae.
> (vii) Separated yard waste or food waste, including recycled cooking and trap grease.

Id.

[34] *Id.* § 7545(o)(1)(I)(i).

[35] *Id.* § 7545(o)(1)(I)(iv).

[36] 75 Fed. Reg. 14670 (Mar. 26, 2010) (codified at 40 C.F.R. Pt. 80) [hereinafter RFS2 Final Rule].

[37] *Id.* § 80.1454. Foreign producers must show compliance through a third-party compliance survey. *Id.* § 80.1454(h).

[38] *Id.* The 2007 baseline is 402 million acres. *Id.*, Preamble at 71. The USDA makes long-run projections of the US agricultural sector, including for land that is planted, harvested, and idled. USDA, *Long-Term Agricultural Projection Tables*, available at http://usda.mannlib.cornell.edu/MannUsda/viewStaticPage.do?url=http://usda.mannlib.cornell.edu/usda/ers/94005/./2007/index.html.

[39] RFS2 *Final Rule*, *supra* note 36, at § 80.1454(g)(2). Presumably, the forest management plan would address compliance with the ecological communities provision.

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(3) The growth and use of cultivated invasive or noxious plants and their impacts on the environment and agriculture."[40]

The first assessment is due in 2010, and then every three years thereafter.[41] With the exception of corn and corn stover, what data for cellulosic biomass EPA and DOE will base their assessment on is unclear, as so few commercial acres currently are in production.

2. The Biomass Crop Assistance Program (BCAP)

The 2008 Farm Bill established BCAP as the first energy biomass cropping subsidy program in the U.S.[42] USDA's Commodity Credit Corporation (CCC) proposed implementing regulations in February 2010.[43] The first part of the program, which CCC implemented without rulemaking throughout 2009,[44] provides a matching payment for "eligible material" collection, harvest, storage and transportation (CHST) to a qualified biomass conversion facility (BCF) for heat, power, fuel, or bio-based products.[45] The Project Areas Program,[46] which remains unimplemented, will pay a portion of the cost for biomass producers to establish "eligible crops," which include perennial non-woody and woody crops.[47] CCC is required to evaluate project area applications based on, in part, its "impact on soil, water, and related resources."[48]

BCAP payments only can issue for "renewable biomass,"[49] which has two basic meanings under the statute and proposed regulations, and which underlies the definitions of "eligible crop" and "eligible material." First are land use restrictions that include a prohibition again cropping on lands with native vegetation not previously tilled for an annual crop as of the date the proposed rule is finalized (like RFS2), or on land that receives conservation, wetland, or grassland reserve payments.[50] In addition, renewable biomass does not include Title I crops so as not to incentivize energy production from food crops.[51] Unlike RFS2, BCAP requires

[40] *Id.* § 204(a)(1)-(3).
[41] *Id.* § 204(a).
[42] Food, Conservation, and Energy Act of 2008, Pub. L. No. 110-246, §9001, 122 Stat. 1651 (2008) (codified at 7 U.S.C. § 8111) [hereinafter 2008 Farm Bill].
[43] 75 Fed. Reg. 6264-6288 (Feb. 8, 2010) (to be codified at 7 C.F.R. Pt. 1450).
[44] For a procedural history of BCAP, *see generally* Jody M. Endres, *et al.*, *The Biomass Crop Assistance Program: Orchestrating the Government's First Significant Step to Incentivize Biomass Production for Renewable Energy*, 40 ENVTL. L. REP. 10066 (Jan. 2010).
[45] 75 Fed. Reg. 6284 (to be codified at 7 C.F.R. Subpart B) [hereinafter BCAP Proposed Rule].
[46] *Id.* Subpart C.
[47] *Id.* § 1450.213.
[48] *Id.* § 1450.202(f).
[49] "Renewable biomass" under the Farm Bill generically includes plant material from private and Indian lands such as: feed grains, other agricultural commodities, other plants and trees, and algae; wastes (crop residues, other wastes (excluding high-value uses), animal wastes, and food and yard wastes). BCAP Proposed Rule, *supra* note 45, § 1450.2.
[49] *Id.* § 1450.3(b).
[50] *Id.* § 1450.204(b)(2)-(5).
[51] 7 U.S.C. § 8111(a)(4) (2008 Farm Bill BCAP provision). Title I crops include the whole grains of barley, corn, grain sorghum, oats, rice, or wheat; honey; mohair; oilseeds such as canola, crambe, flaxseed, mustard seed, rapeseed, safflower seed, soybeans, sesame seed, and sunflower seeds; peanuts; pulse crops such as small chickpeas, lentils, and dry peas; dairy products; sugar; wool; and cotton boll fiber. *See* BCAP Proposed Rule, *supra* note 45, at § 1450.2. Project area payments preclude any plant deemed noxious or invasive by the CCC. *Id.*

CHST payments are also not available for animal waste and byproducts, food and yard waste, and algae. *Id.*

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sustainable agronomic and forestry practices for biomass.[52] "Eligible material" under the CHST program includes biomass harvested from either National Forest System or Bureau of Land Management land for preventative or restorative purposes, but only according to federal land management plans.[53] Further, BCAP requires both CHST and Project Area participants to "implement and adhere to a *conservation plan* prepared in accordance with BCAP guidelines, as established and determined by CCC" (emphasis added),[54] or follow an existing plan.[55] "Conservation plan" is defined in the proposed regulation as:

> a record of the participant's decisions and supporting information for treatment of a unit of land or water, and includes a schedule of operations, activities, and estimated expenditures needed to solve indentified natural resource problems by devoting eligible land to permanent vegetative cover, trees, water, or other comparable measures.[56]

Program participants also must comply with highly erodible land (HEL) and wetland conservation requirements that apply generally in USDA subsidy programs and are addressed in conservation plans for those programs.[57] CCC resists, however, adding to BCAP erosion requirements beyond what is required for highly erodible lands–for example, to address erosion problems by watershed and not by the HEL classification of individual tracts.[58]

3. California's Multi-Faceted GHG Regulatory Programs

California's comprehensive GHG legislation, first enacted in 2006,[59] has generated many sector-specific regulations, including a Low Carbon Fuel Standard (LCFS),[60] Renewable Electricity Standards (RES),[61] mobile source emissions rules for light-duty vehicles,[62] and a

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[52] One sustainability concern that is missing from BCAP is the value of biomass in reducing GHGs. The BCAP matching payments proposed rule, however, does propose increased payment options for cellulosic or advanced biofuels. *Id.* § 1450.106, options 2 and 3.

[53] *Id.* § 1450.2. Federal land management practices include those established by the Healthy Forests Act. *Id.* Other requirements include that the renewable biomass are byproducts of preventative treatments, and would not otherwise be used for "higher value" products. The preamble explains that "higher value products" are typically used as inputs for particle board, fiberboard, plywood, or other wood product markets. BCAP Proposed Rule, *supra* note 45, at 6266.

[54] *Id.* § 1450.3(b).

[55] *Id.* § 1450.3(c).

[56] *Id.* § 1450.2. CCC proposes that project area applicants also delineate conservation practices in the application. 75 Fed. Reg. 6271. The proposed rule states in the preamble that for project areas, the conservation plan is defined according to 7 C.F.R. § 1410.2, which is the CRP conservation plan part of the rule. BCAP Proposed Rule, *supra* note 45, at 6272. "Forest Stewardship Plans" are also defined in the regulation, *id.* at 6281, but are not the focus of this article.

[57] *See infra* text at note 122.

[58] BCAP Proposed Rule, *supra* note 45, at 6265.

[59] Assembly Bill (A.B.) No. 32 (Sept. 27, 2006) (codified at Cal. Health & Safety Code 25.5, Section 38500), *available at* http://www.leginfo.ca.gov/pub/05-06/bill/asm/ab_0001-0050/ab_32_bill_20060927_chaptered.pdf.

[60] *See* Air Resources Board, Proposed Modified Regulation Order (Sept. 23, 2009), http://www.arb.ca.gov/regact/2009/lcfs09/lcfs2ndmodtxt.pdf; Air Resource Board, Resolution 09-31 (Apr. 23, 2009), *available at* http://www.arb.ca.gov/regact/2009/lcfs09/res0931.pdf [hereinafter LCFS].

[61] *See* Senate Bill (S.B.) 1078 (Sept. 12, 2002) (amending Chapter 2.3 of Part 1 of Division 1 of the Pub. Util. Code), http://www.energy.ca.gov/portfolio/documents/SB1078.PDF; Assembly Bill (A.B.) 1969 (Apr. 24, 2006), *available at* http://info.sen.ca.gov/pub/05-06/bill/asm/ab_1951-

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proposed cap-and-trade regulation.[63] In the same year that the Global Warming Solutions Act issued, the California Biomass Collaborative prepared a Biomass Roadmap for the CEC that emphasized the need to develop a *sustainable* energy biomass supply.[64]

In addition to reductions in GHG emissions through increased use of biofuels and biomass in the transportation and electricity sectors, the California Air Resources Board (ARB) and Energy Commission (CEC) (the agency with primary responsibility for implementing renewable portfolio standards) currently are in the process of developing concurrent practice-based sustainability standards for biomass feedstocks. ARB has indicated in recent LCFS rulemaking that it will issue draft sustainability metrics for biofuels feedstock by 2012.[65] ARB states that components of a sustainable system include, but are not limited to "well defined sustainability criteria," "indicators on a plantation level," the assessment of the cumulative impacts of sustainability standards at the "regional or global level," and certification.[66] ARB is working with all stakeholders in developing the standards[67] through a Sustainability Workgroup formed in mid-2010.[68] Similar forestry sustainability standards are in development through the Interagency Forestry Working Group.[69]

B. Sustainability Through Certification to a Standard

Although the RFS2, BCAP and California regulations do not (yet) require sustainability certification for energy biomass, certification to a standard is one way to guarantee the sustainability of biomass.[70] Certification "is the process whereby an independent third-party

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2000/ab_1969_cfa_20060420_170234_asm_comm.html (adding a feed-in-tariff requirement); Exec. Order S-21-09 (Sept. 15, 2009) (ordering ARB to adopt, by July 31, 2010, a regulation setting a 33% renewable energy target by 2020), *available at* http://gov.ca.gov/executive-order/13269/.

[62] California is issuing regulations to implement Assembly Bill No. 1493 (Pavley) (July 22, 2002) (codified at Cal. Health & Safety Code section 42823), *available at* http://www.arb.ca.gov/cc/ccms/documents/ab1493.pdf. The Air Resources Board (ARB) promulgated the regulations in 2005, *see* Final Regulation Order, CAL. CODE REGS. TIT. 13, §1900 *et seq.*, *available at* http://www.arb.ca.gov/regact/grnhsgas/revfro.pdf.

[63] Air Resources Board, *Preliminary Draft Regulation for a California Cap-and-Trade Program* (Nov. 24, 2009), *available at* http://www.arb.ca.gov/cc/capandtrade/meetings/121409/pdr.pdf.

[64] CAL. ENERGY COMM'N, A ROADMAP FOR THE DEVELOPMENT OF BIOMASS IN CALIFORNIA - DRAFT ROADMAP DISCUSSION
DOCUMENT 47-58(2006), *available at*
http://biomass.ucdavis.edu/materials/reports%20and%20publications/2006/2006_Biomass_Roadmap.pdf.

[65] CAL. ENVTL. PROT. AGENCY, AIR RES. BD., 1 PROPOSED REGULATION TO IMPLEMENT THE LOW CARBON FUEL STANDARD -
STAFF REPORT: INITIAL STATEMENT OF REASONS ES-3, VII-31(2009), *available at* http://
www.arb.ca.gov/regact/2009/lcfs09/lcfsisor1.pdf.

[66] *Id.* at VII-32.

[67] *Id.*

[68] Air Resources Board, *Low Carbon Fuel Standard Sustainability Workgroup*,
http://www.arb.ca.gov/fuels/lcfs/workgroups/lcfssustain/lcfssustain.htm (last visited X).

[69] Cal. Energy Comm'n, *Inter-Agency Forestry Working Group*,
http://www.climatechange.ca.gov/forestry/index.html (last visited X). For details on the IFWG, *see* Jody M. Endres, *Barking Up the Wrong Tree: Can Bioenergy Policies Adequately Protect Forests and Accurately Account for Sequestration?*[Should have an acceptance soon].

[70] *See* Norbert Schmitz, *Certification to ensure sustainable production of biofuels*, 2 BIOTECHNOLOGY JOURNAL 1474 (Dec. 2007). *See generally*, Jody M. Endres, *Clearing the Air: The Meta-Standard Approach to Ensuring the Environmental and Social Sustainability of Biofuels*, 28 VA. ENVTL. L. REV. 73 (2010) (reviewing the universe of biofuels sustainability standards worldwide).

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(called a certifier or certification body) assesses the quality of [agronomic] management in relation to a set of predetermined requirements (the standard)."[71] *Standards* "define the aim of certification, and describe the product or production process specific requirements to be fulfilled by certification."[72] *Principle* statements establish the standard's general aspirations by category, *criteria* describe in further detail the principle-specific requirements, and *indicators* provide the details required for measurement.[73] Criteria and indicators can either be prescriptive or performance-based.[74]

The organic food sector was the first to develop a system of certification based on a set of standards beginning in the 1990s, followed shortly thereafter by the forestry sector.[75] Sustainability standards for agriculture other than those for organic food have been slower to develop, particularly in the U.S.[76] While the EU has required environmental cross-compliance from agricultural commodity producers since 2003 through its Common Agricultural Policy (CAP),[77] agricultural producers in the U.S. are subject to few mandatory conservation measures.[78]

Only with the advent of renewable energy policy in the past few years, however, has the prospect of sustainability standards for agriculture, beyond organic farming, emerged at the governmental as well as voluntary levels.[79] Emerging standards are performance-based, relying on management practices to achieve environmental goals such as reduction of air, water and soil pollution, and preservation of biodiversity.[80] Typical standards begin with a principle related to management planning that guides each successive principle, as well as criteria within each principle that require principle-specific planning (e.g., nutrient management planning, environmental/habitat assessment). Other environmental principles contained in sustainability standards relate to water, air, soil, and biodiversity protection. Development of private biomass sustainability standards wisely has involved of a variety of stakeholders because priorities and perceptions between them may vary significantly (e.g., industry and trade, buyers and consumers, producers and managers, governments and academic representatives, environmental and labor non-governmental organizations).[81]

C. The Council for Sustainable Biomass Production (CSBP) Provisional Standard

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[71] Ewald Rametsteiner & Markku Simula, *Forest certification—an instrument to promote sustainable forest management?* 67 J. ENVTL. MGMT. 87, 88 (Aug. 2002).
[72] Iris Lewandowski & André Faaij, *Steps toward the development of a certification system for sustainable bio-energy trade*, 30 BIOMASS AND BIOENERGY 83, 89 (2006).
[73] *Id.* at 90.
[74] Subhas Sikdar, *Sustainable Development and Sustainability Metrics*, 49 AMER. INST. CHEM. ENG. J. 1928, 1930 (Aug. 2003).
[75] Lewandowski & Faaij, *supra* note 72, at 84.
[76] *Id.* at 88.
[77] *See* The European Commission, *Agriculture and Rural Development, Agriculture and the Environment: Introduction*, available at http://ec.europa.eu/agriculture/envir/index_en.htm (describing generally how environmental concerns are integrated into EU agricultural policy).
[78] *See generally* Angelo, *supra* note 6. Private efforts are ongoing in the U.S. to create a voluntary sustainability standard for agriculture, including the Stewardship Index for Specialty Crops, *available at* http://www.stewardshipindex.org/, and the Leonardo Academy Sustainable Agriculture Standard (SCS-001) for food and fiber commodity crops, *available at* http://www.leonardoacademy.org/programs/standards/agstandard/development.html.
[79] *See* Endres, *supra* note 70, at 75-77.
[80] *Id.* at 93-94.
[81] *Id.* at 100-101.

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Standards development for the global agricultural production system, including for energy biomass, is becoming populated increasingly by private actors who seek alternatives to command and control regulation.[82] For example, the United Kingdom's Renewable Transport Fuels Obligation (RTFO) requires sustainability reporting for biomass, but allows obligated parties to use private, third-party certifications.[83] The Roundtable for Sustainable Biofuels (RSB), a private, transnational, multi-stakeholder group, is in the process of implementing its practice, chain of custody, and certification body pilot standards for biomass sustainability.[84] In the U.S., the Council for Sustainable Biomass Production (CSBP) began the process of developing biomass and biofuels standards in early 2007.[85] Its domestic, multi-stakeholder effort among industry, producers, academics, and non-governmental organizations lead to issuance of a provisional standard for biomass in April 2010.[86] CSBP will begin field-testing the standard for the 2010 growing season, with a full standard by 2012.[87]

The CSBP standard contains nine main principles: integrated resource management planning,[88] soil,[89] biological diversity,[90] water,[91] climate change,[92] socio-economic well-being,

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[82] Doris Fuchs, *et al.*, *Actors in private food governance: the legitimacy of retail standards and multistakeholder initiatives with civil society participation*, JOURNAL OF AGRICULTURE AND HUMAN VALUES (Sept. 19, 2009).

[83] RENEWABLE FUELS AGENCY, CARBON AND SUSTAINABILITY REPORTING WITHIN THE RENEWABLE TRANSPORT FUEL OBLIGATION:
TECHNICAL GUIDANCE PART 1 2 (2009) [hereinafter Technical Guidance Part 1], *available at* http:// www.renewablefuelsagency.org/_db/_documents/Carbon_and_Sustainability_Guidance_ Part_One.pdf; *see also* Endres, *supra* note 60, at 80-92.

[84] Roundtable for Sustainable Biofuels, *available at* http://energycenter.epfl.ch/page85866.html [check to see if update needed near publication time. . . this keeps changing].

[85] *See generally*, Council for Sustainable Biomass Production, available at http://www.csbp.org/; Draft Standard at 4 (Sept. 11, 2009), *available at* http://www.csbp.org/files/survey/CSBP_Draft_Standard.pdf.

[86] CSBP, DRAFT PROVISIONAL FOR SUSTAINABLE PRODUCTION OF AGRICULTURAL BIOMASS (Apr. 14, 2010), *available at* http://csbp.org/files/survey/CSBP_Provisional_Standard.pdf. U.S. government representatives participate in an advisory capacity.

[87] *Id.* at 7.

[88] *Id.* at 12-13. In developing the IRMP, producer must first assess their operation to formulate baseline information, which in turn informs resource goals and land management objectives to meet the criteria and indicators of the standard that also are incorporated into the IRMP. *Id.* "Assessments typically include gathering information on crop production, soils, natural vegetation cover, rare species and communities, existing wildlife habitats and aquatic ecosystems, and past and current land and water conservation activities." *Id.* at Indicator 1.1S1; *Id.* at Criterion 1.3.

[89] Principle 2-Soil requires producers to maintain or improve soil health and quality by reducing erosion, maintaining soil carbon and nutrients at "appropriate levels," and maintaining the chemical, physical, and biological soil properties. *Id.* at 12. Although only gold level certification requires "comprehensive management planning and implementation of practices," *id.* at Indicator 2.1G1, silver-level certification does require a soil assessment, including for soil nutrient levels, as well as a nutrient management plan in line with Natural Resource Conservation Service (NRCS) planning if nutrients are applied. *Id.* at Indicator 2.1S1. Producers must achieve a score of "T" in the Revised Universal Soil Loss Equation (RUSLE2), *see infra* text at notes X, and maintain residues on the field for long-term soil health and to prevent erosion. *Id.* at Indicator 2.1S7. Producers must achieve a positive score on the (SCI), *infra* Part III.B.1.b, as a proxy for soil carbon maintenance. *Id.*at Indicator 2.1S8.

[90] Principle 3-Biodiversity seeks to protect native wildlife and ecologically-sensitive areas by requiring that the producer, working together with resource agencies and in conjunction with eco-regional, state and national plans, to assess vegetative cover and habitats on the farm and landscape levels, and implement plans and practices to protect them. *Id.* at Criterion 3.1; Indicator 3.1S1. Protected species include: (1) threatened or endangered under the Endangered Species Act (ESA); (2) imperiled, critically imperiled, or vulnerable by NatureServe and Natural Heritage Programs; (3) important ecological sites in eco-regional plans; and, (4) important habitat and wildlife

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legality,[93] transparency, and continuous improvement[94].[95] Each principle contains criteria and indicators, as well as implementation guidance, and is divided into two compliance levels: silver and gold. While the standard will set metrics where necessary, it recognizes that metrics can be more expensive to test and implement than gauging performance through management practices.[96] The preamble notes that management practices can serve as an effective proxy for metrics, as demonstrated by the management practices identified by federal and states agencies, universities, and other organizations.[97] Many of the CSBP provisions are addressed, at least in part, by NRCS practice standards.

III. Natural Resources Conservation Service (NRCS) Conservation Planning and Practices As a Framework for Meeting Biomass Sustainability Standards

The CSBP has made great progress toward a framework that producers are currently field testing. Leading scientists agree, however, that "there is not yet a firm consensus on the extent

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species in state wildlife plans. *Id.* at Indicators 3.1.S1, S2. Practices to protect biodiversity include polycultured stands, timing of mechanical operations so as not to disturb wildlife, and leaving appropriate ground cover. *Id.* at Indicator 3.1.S2. Silver-level producers must control non-crop invasive species, while gold-level producers must work to enhance biodiversity by reducing the incidence of non-crop species. *Id.* at Indicators 3.1S5, G5. Gold-level certification adds enhancement and restoration of habitat at landscape levels (e.g. corridors, buffers, unfragmented habitat blocks, prescribed burning). *Id.* at Indicator 3.1G1, G4. Producers must also document land-use as of January 1, 2008, and only convert land from certain other uses to another. *Id.* at Indicator 3.3.S1. A land conversion matrix, and an explanation of issues to be further resolved, is contained in Annex C. *Id.* at 32-34.

[91] The standard contains many criteria related to water quality in Principle 4. The first requires an integrated resource management plan to address nutrients and agrochemical application. *Id.* at 4.1.S1. Producers must also test soil and plant tissue as a measure of agrochemical use, as recommended by NRCS. Where manure is applied, a Comprehensive Nutrient Management Plan must be in place. *Id.* Otherwise, the IRMP suffices to control nutrient application, and pesticide drift and runoff. *Id.* In addition, producers are required to use best practices to avoid erosion that degrades water quality, test waste-water irrigation, test for contamination in biosolids, and use best management practices for nitrogen and phosphorus application. *Id.* at Indicators 4.1S2, S3, S4, S5, S6. Pesticide application cannot harm humans or the environment, and use must score "very low" on the NRCS's Windows Pesticide Management Tool. *Id.* at Indicators 4.1S7, S8. Producers must use integrated pest management (IPM) where practical. *Id.* at Indicator 4.1S7.

In terms of water *quantity*, the standard requires producers to maintain irrigation management plans and protect against salinity, and at the gold level, reduce water usage. *Id.* at Indicators 4.2S1, S5, G1. Producers must maintain stream flow and temperature, and avoid hypoxia, to protect aquatic ecosystems. *Id.* at Indicators 4.3S2, S3, S4.

[92] The GHG and soil principles are in great part integrated in relation to maintaining and building soil carbon, and reducing excess nutrient application. The CSBP standard ambitiously aims to measure GHG emissions from agronomic practices, either through individual measurements or default values. *Id.* at 35-36. As part of field testing, producers are required to report yield, inputs (fertilizers, pesticides, fuel), land management practices, and soil carbon, among other factors, as part of a GHG scoring tool that the CSBP is currently developing with the help of an expert panel. *Id.* at 14 (Criterion 2.1).

[93] Although not addressed directly in the standard, it is under this principal that the Council has resolved the issue of the use of genetically-modified organisms (GMOs). *Id.* at 10.

[94] CSBP-certified producers also make a commitment to "continuously improve practices and outcomes based on the best available science" through monitoring and certification audits. *Id.* at 25. At the gold-level, producers must participate in programs that expand public knowledge of sustainable biomass practices, including research trials in collaboration with universities and the federal government. *Id.* at Indicator 9.2G1.

[95] *Id.* at 10-11 (principles in brief).

[96] *Id.* at 6-7. The drafters question whether a "causal relationship" can be established in certain instances between the resource at issue and a producer's practices. *Id.*

[97] *Id.*

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of [the potential impacts of biofuels production on land use and biodiversity] and how to measure them."[98] Therefore, policymakers should consider whether existing agro-environmental programs in the U.S. can guide nascent biomass sustainability efforts by providing much-needed baseline planning frameworks for, and assessments of, land-uses and natural resource concerns. Existing programs also can serve as a platform for developing or fortifying agronomic measurement tools, and designing biomass-specific conservation practices, which greatly inform standard implementation. Along with land grant universities and government agencies such as the Department of Energy (DOE), the Environmental Protection Agency (EPA), and other departments within USDA, the Natural Resource Conservation Service (NRCS) plays a central role in assisting producers with the conservation requirements of commodity subsidy programs and other conservation programs, particularly in the design and implementation of conservation[99] plans and development of agronomic practices to meet planning goals.[100] NRCS is postured to play the same important role in implementation of biomass sustainability standards.

A small number of conservation provisions in federal law are mandatory in order to receive payment for commodity production; the main two include: reducing erosion on highly erodible land (HEL);[101] and, a prohibition against filling of wetlands[102] (commonly known as "sodbuster" and "swampbuster").[103] Participation in the majority of conservation programs, however, is entirely voluntary for agricultural producers. Conservation program provisions are typically found in Title II of Farm Bills that issue every five years, and either provide for land retirement (the Conservation Reserve,[104] Wetlands Reserve,[105] and Grasslands Reserve Program (GRP)[106] programs) or are for "working lands" (the Environmental Quality Incentives Program (EQIP),[107] Wildlife Habitat Incentives Program (WHIP),[108] Farm and Ranch Lands Protection Program (FRPP),[109] and the Conservation Stewardship Program (CSP),[110] and BCAP[111]).

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[98] Dale, *et al.*, *supra* note 27, at 1.

[99] The Soil Conservation and Domestic Allotment Act of 1935–the statutory foundation of NRCS conservation programs–defines "conservation" as the prevention of soil erosion, which "preserves natural resources, control[s] floods, prevent[s] impairment of reservoirs, protect[s] public health, public lands and relieve[s] unemployment. . . ." Pub. L. No. 74–46 of 1935 (codified at 16 U.S.C. §§ 590a-590f) [hereinafter SCDA of 1935]. *See generally*, Peter R. Hobbs, *et al.*, *The role of conservation agriculture in sustainable agriculture*, 363 PHIL. TRANS. R. SOC. B. 543 (2007) (describing agricultural conservation).

[100] The same 1935 Act transferred the Soil Erosion Service from the Department of the Interior to USDA, and renamed it the Soil Conservation Service. *See* SDCA of 1935, *supra* note 99. In 1994, the Department of Agriculture Reorganization Act renamed it the Natural Resources Conservation Service and made several substantive changes to its mission. *See* The Federal Crop Insurance Reform and Department of Agriculture Reorganization Act of 1994, Pub. L. No. 103-354, 108 Stat. 3178 (1994) (codified at 7 U.S.C. § 6962). The Act added to the duties of the NRCS authority over five different conservation programs administered by other USDA agencies, thus broadening its mission to environmental and natural resource conservation. *See generally* NRCS, NATIONAL AGRONOMY MANUAL (2002), *available at* http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17894.wba [hereinafter NAM].

[101] 16 U.S.C. §§ 3811-3814.

[102] 16 U.S.C. §§ 3821-3824.

[103] For an overview of conservation requirements in U.S. agricultural subsidies, *see* CHARLES E. HANRAHAN & JEFFREY ZINN, GREEN PAYMENTS IN U.S. AND EUROPEAN UNION AGRICULTURAL POLICY (Cong. Research Serv. Nov. 22, 2005), *available at* http://www.nationalaglawcenter.org/assets/crs/RL32624.pdf.

[104] 16 U.S.C. §§ 3831-3835a.

[105] 16 U.S.C. §§ 3837-3835f.

[106] 16 U.S.C. §§ 3838n-3838q.

[107] 16 U.S.C. §§ 3839aa-3839aa-9.

[108] 16 U.S.C. § 3839bb-1.

[109] 16 U.S.C. § 3838i.

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NRCS's framework for conservation relies on policies (general manuals), procedures (handbooks), technical guidance (field office technical guidance (FTOG)), tools, and program guidance (manuals). *General manuals* provide the foundational, over-arching guidance for NRCS's conservation planning and practices. General Manuals (Title) 180[112] and 401[113] describe NRCS policy nationwide for development of technical guidance for the conservation practice standards that producers incorporate into their planning. *Manuals* establish guidance and policy aimed at implementation of specific federal programs, such as the National Food Security Act Manual (to implement HEL and wetland requirements),[114] and the other federal programs listed above.[115] One of the most significant manuals, however, in terms of future development of biomass cropping practices, is the National Agronomy Manual (NAM).[116] The NAM "contains policy for agronomy activities and provides technical procedures for uniform implementation of agronomy tools and applications."[117]

In addition to general manuals and manuals, NRCS uses *handbooks* that further detail procedures for field office staff to use in implementing conservation policies and practices. Two of these handbooks are of particular relevance to setting biomass sustainability standards: the National Planning and Procedures Handbook (NPPH),[118] and the National Handbook of Conservation Practices (NHCP).[119] Additional handbooks include the National Environmental Compliance Handbook (NECH), which contains compliance guidance for NEPA, ESA, and other federal environmental requirements, [120] the Comprehensive Nutrient Management Planning Handbook, which details the planning process and standards for animal feeding operations as well as range and pastures,[121] and the Technical Service Provider Handbook.[122] Technical Service Providers will be the critical link between biomass producers and the sustainability practices NRCS may develop.

At the ground level, the NRCS *Field Office Technical Guidance* (FOTG) directs the planning process and implementation of conservation practices. In addition to its role as the "primary scientific" reference for NRCS, the FOTG contains county-level resource targets and practices that achieve those targets.[123] Each state's FOTG is approved by the State Conservationist. For each state, the FOTG contains five sections:

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[110] 16 U.S.C. §§ 3838d-3838g.
[111] 7 U.S.C § 8111. Congress placed BCAP under the energy title (IX), instead of under Title II (conservation).
[112] NRCS, GENERAL MANUAL, Title 180, Part 409 (Conservation Planning Policy), §§ 409.0 – 409.11.
[113] NRCS, GENERAL MANUAL, Title 450, Parts 401-412 (Technology).
[114] The Manual contains, for example, a HEL soil erodibility index. *See* THE NATIONAL FOOD SECURITY ACT MANUAL, Title 180, Part 511, Subpart A, § 511.01.
[115] NRCS Manuals Title 440 (Programs), Parts 514 (WRP), 515 (EQIP), 517 (WHIP), 518 (CSP), and 523 (FPPA).
[116] NAM, *supra* note 100.
[117] *Id.* at 500-1.
[118] NRCS, Title 180, Part 600, NATIONAL PLANNING PROCEDURES HANDBOOK [hereinafter NPPH]
[119] NRCS, Title 450, NATIONAL HANDBOOK OF CONSERVATION PRACTICES.
[120] NRCS, Title 190, Part 610, NATIONAL ENVIRONMENTAL COMPLIANCE HANDBOOK.
[121] NRCS, Title 190, Part 620, COMPREHENSIVE NUTRIENT MANAGEMENT PLANNING, NATIONAL RANGE AND PASTURE HANDBOOK.
[122] NRCS, Title 180, Part 610, TECHNICAL SERVICE PROVIDER HANDBOOK. The NRCS can pay private technical service providers (TSPs) to assist producers in implementing conservation programs. *Id.* § 610.0.
[123] NRCS, ELECTRONIC FIELD OFFICE TECHNICAL GUIDE (eFOTG), *available at* http://www.nrcs.usda.gov/technical/efotg/.

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(I) general resource references (including links to manuals and handbooks, modeling tools, maps, watershed information, and agricultural laws and regulations);
(II) natural resources information (detailed information on soil, water, air, plant, and animal resources, as well as soil surveys, wildlife habitat evaluation guides, water quality guides, and cropland production tables);
(III) conservation management systems (the resource concern and accompanying quality criteria);
(IV) practice standards and specifications (detailed requirements for installing the practice in the particular state); and,
(V) conservation effects (how the conservation practice affects each identified resource concern in the state).[124]

A. NRCS's Conservation Planning and Practices Framework

NRCS tailors its services to the individual goals of the producer, depending on the federal conservation program for which the producer seeks payment. Regardless of the subsidy program, however, NRCS follows a general framework to identify "resource concerns" and in designing conservation plans and practice. The choice of conservation practice implemented depends on the resource concern at issue and the NRCS quality criteria that applies to that resource concern.

1. Identifying Resource Concern(s)

Various federal Acts direct NRCS to continuously assess the needs and status of soil, water, and related natural resources in the U.S.[125] The primary mechanism for gathering resource information is through The National Resource Inventory (NRI). The NRI uses statistical surveys based on sample data taken at various sites within states through onsite visits, remote sensing, imagery, and "ancillary materials" containing data.[126] NRCS coordinates the NRI with other government resource assessments "when feasible, practical, and consistent with NRCS' conservation mission."[127] NRCS conducts the NRI on an annual basis [128] to estimate land use, the landscape and soil, ecological site information, rangeland health, invasive/noxious plant presence, disturbance indicators, conservation practices and resource concerns, plant

[124] *Id.* The NRCS's eFTOG website contains a U.S. map that the user can click on to find state-specific requirements. NRCS often combines sections III and IV within a table for each general resource concern. Producers can click on each resource concern within the eFTOG (soil, water, air, plant, animal, human) to find descriptions of: (1) the specific concerns within that category; (2) the national quality criteria; (3) measurement units; (4) state-specific criteria; and (5) assessment tools.
[125] NRCS, GENERAL MANUAL, Title 290, Part 400 (Resources Inventory), Subpart A, § 400.1(a) (detailing the legislation) [hereinafter Resources Inventory General Manual].
[126] *Id.* at § 400.11(b); *see also* Jerry T. Harlow, *The History of the Soil Conservation Service National Resource Inventories* (NRCS 1994), *available at* http://www.nh.nrcs.usda.gov/technical/Publications/NRIHistory.pdf (detailing successive national resource inventories).
[127] RESOURCES INVENTORY GENERAL MANUAL, *supra* note 125, at § 400.11(d).
[128] From 1977-1997, NRCS conducted the survey every 5 years. Starting in 2000, NRCS began conducting the survey every year. *See* NRCS, *NRI/Wetlands: Questions and Answers, available at* http://www.nrcs.usda.gov/technical/NRI/qa.html.

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composition and patterns and plant production, cover, density, and height.[129] "Resource concerns" are the problems NRCS identifies in a NRI that in turn form the building block of quality criteria in conservation planning and management, as well as support overall development of agro-environmental policy and programs.[130] NRCS categorizes resource concerns by the areas in which they can occur: soil, water, air, plant and animal ("SWAPA").[131] NRCS has also added human resources ("H") and energy ("E") to the SWAPA equation.[132]

2. Conservation Management Practices and Quality Criteria

NRCS' National Agronomy Manual (NAM) provides a general reference of conservation practices, which NRCS defines as "a specific treatment, such as a structural or vegetative measure, or management technique, commonly used to meet specific needs in planning and implementing conservation for which [quality] standards and specifications have been developed."[133] The first NAM chapters detail water and wind erosion and the tools that measure them, as well as control measures. Succeeding chapters address cropping practices (crop rotation, tillage, and residues), water management (soil moisture), plant attributes (vegetative stabilization and suitability for crop production systems), cropland conservation management systems, soils (surveys, interpretation, and management), and data management.[134] Each chapter also contains a related bibliography of foundational research. The chapter on cropland conservation management systems identifies resource concerns and the management practices/treatments that can improve the resource or reduce harm to it.[135] The management practices are categorized as *National Standard Practice Codes*.

Compared to the NAM that is more general in nature, the National Handbook of Conservation Practices (NHCP) more specifically sets conservation practices and minimum quality criteria[136] for each resource concern, and then outlines "why and where the [conservation] practice is applied" to meet the quality criteria.[137] Each NHCP conservation

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[129] NRCS, NATIONAL RESOURCES INVENTORY HANDBOOK OF INSTRUCTIONS FOR RANGELAND FIELD STUDY DATA COLLECTION 1-1 (May 2007), *available at* http://www.ncgc.nrcs.usda.gov/products/nri/range/2007range.html [hereinafter 2007 NRI].

[130] *Id.*, Subpart B, § 400.10.

[131] 2007 NRI, *supra* note 129, at 13-2.

[132] NRCS, CONSERVATION STEWARDSHIP PROGRAM: PROGRAMMATIC ENVIRONMENTAL ASSESSMENT 7 (June 2009), *available at* http://www.nrcs.usda.gov/programs/env_assess/fonsi_files/CSP_Env_Assess_Final_060809.pdf. This is consistent with resource concerns identified in scientific literature. *See e.g.*, L. Reijnders, *Conditions for the sustainability of biomass based fuel use*, 34 ENERGY POLICY 863 (May 2006).

[133] NATIONAL AGRONOMY MANUAL, supra note 100; *id.* at Subpart G (Glossary).

[134] *Id.* at Parts 500-509. The pest and nutrient management portions remain under development.

[135] *Id.* at 507-3.

[136] NRCS defines quality criteria as "[a] quantitative or qualitative statement of a treatment level required to achieve a [resource management system] for identified resource considerations for a particular land area. It is established in accordance with local, state, and federal programs and regulations in consideration of ecological, economic, and social effects. *Id.* at 600-G-70-8.

[137] NRCS, HANDBOOKS, Title 450 (National Handbook of Conservation Practices), *available at* http://www.nrcs.usda.gov/technical/Standards/nhcp.html [hereinafter NHCP]; NRCS, NHCP Home Page, http://www.nrcs.usda.gov/technical/standards/nhcp.html (last visited X).

NRCS defines quality criteria as "[a] quantitative or qualitative statement of a treatment level required toachieve an [resource management system] for identified resource considerations for a particular land area. It is established in accordance with local, state, and federal programs and regulations in consideration of ecological, economic, and social effects. *Id.* at 600-G-70-8.

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practice is broken into its separate practice, ranging from "brush management" to "windbreak/shelterbelt renovation."[138] Within these practices, to measure individual effectiveness, NRCS may incorporate modeling tools such as the Soil Conditioning Index (SCI) to measure whether, for example, cover cropping has a positive effect on soil organic matter.[139] These cornerstone practices and quality criteria then are tailored to state-specific conditions within state-specific FOTG.[140]

Where no practice standard exists, the NHCP establishes procedures for developing an interim standard, including interfacing with researchers from universities and the Agricultural Research Service (ARS),[141] producers, industry, and NRCS field offices.[142] These procedures for interim development of practices and quality criteria will be critical to the development of standardized practices and quality criteria for biomass cropping, where many conservation practices and effects are only beginning to be understood.

3. Conservation Planning

The goal of conservation planning is to provide producers a framework to implement the conservation management practices detailed above to protect soil, water, air, plant, and animal resources, while at the same time "considering the client's economic and social needs."[143] The

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[138] NHCP, *supra* note 137. *See e.g.*, *infra* text and note at X (describing the national conservation practice standard for pest management and water quality).

[139] NRCS, *Conservation Practice Standard: Cover Crop*, Code 340 (May 2006), available at ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/340.pdf; *see also* Part III.B.1.b (detailing the Soil Conditioning Index).

[140] NRCS maintains a main webpage where the user can click on an individual state to access that state's FOTG (eFOTG), http://www.nrcs.usda.gov/technical/efotg/ (last visited X).

[141] NRCS, Science and Technology FAQ's, http://www.nrcs.usda.gov/sciencetech_faq.html#science3 (last visited X). The NRCS maintains the NRCS Science and Technology Consortium to "acquire, develop, and transfer technology" (including tools and other resource information). *Id.* The Partnership Management Team (PMT) brings together scientists and administrators from NRCS, ARS, and the Cooperative State Research, Education and Extension Service (CSREES) to collaborate on natural resource and environmental issues. *Id.*; *see also* MEMORANDUM OF UNDERSTANDING AMONG THE AGRICULTURAL RESEARCH SERVICE, THE COOPERATIVE EXTENSION RESEARCH, EDUCATION, & EXTENSION SERVICE, AND THE NATURAL RESOURCES CONSERVATION SERVICE UNITED STATES DEPARTMENT OF AGRICULTURE ON NATURAL RESOURCES TECHNOLOGY PARTNERSHIP (Oct. 2, 2000), *available at* http://www.ars.usda.gov/pmt/nrtpmou.html (establishing the PMT).

Part of ARS' s strategic plan for 2006-2011 is to "develop technologies for the sustainable production and collection of biomass feedstocks. . . ." ARS, STRATEGIC PLAN FOR FY 2006-2011 at 6 (Feb. 2007), *available at* http://www.ars.usda.gov/SP2UserFiles/Place/00000000/ARSStrategicPlan2006-2011.pdf. ARS also maintains a National Program for Natural Resources and Sustainable Agricultural Systems, which includes Soil Resource Management (program number 202), Integrated Agricultural Systems (number 207), and Bioenergy and Energy Alternatives (number 307). Each of these programs is conducting research that could lead to development of quality criteria for biomass cropping and harvesting, including: stover removal for biofuel production (the Renewable Energy Assessment Project (REAP)), soil carbon cycling and tillage management, agroforestry inventory and evaluation of GHG mitigation (number 202); environmental and economic consequences of biomass feedstock production in the northern Great Plains and sustainable cropping systems for harvesting corn stover for biomass (number 207); and, sustainable cropping systems for biofuels, improving uses of biofuels' byproducts, and biomass conversion and crop breeding (number 307). ARS, National Programs, http://www.ars.usda.gov/research/programs.htm (last visited X).

[142] NRCS, *NHCP Exhibit 2: Interim Conservation Practice Standards*, available at http://directives.nrcs.usda.gov/OpenNonWebContent.aspx?content=22585.wba.

[143] NRCS, GENERAL MANUAL, Title 180, Part 409, § 409.1(a).

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process holistically centers around development of a "Resource Management System" (RMS).[144] NRCS aims, through the RMS, to establish producer practices and activities that meet or exceed quality criteria developed by NRCS.[145] While NRCS sets the RMS as a minimum goal, it allows producers who are not "ready, willing and able" to meet all criteria to "progressively" plan.[146] Individual components of the RMS include comprehensive nutrient management plans (CNMPs) for animal feeding operations[147] and other "special environmental concerns" that rely on laws, policies, and NRCS guidance outside the NPPH.[148] NRCS encourages producers subject to mandatory conservation (e.g., HEL requirements) to incorporate those practices in the conservation plan.[149] Local conservation districts, and Resource Conservation and Development Councils, play an important role in targeting resource concerns and assisting local NRCS offices and producers with development of area wide and individual conservation plans.[150]

The NPPH primarily guides the NRCS planning process.[151] NRCS coordinates planning within a multi-tiered structure.[152] At the broadest level, area-wide conservation plans and assessments, either lead or assisted by NRCS, guide actions at a watershed or larger geographic level.[153] Area-wide assessments encompass individual operations, "land units" within those

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[144] NPPH, *supra* note 118, at § 600.11(a). An RMS is combination of conservation practices are resource management, identified by land or water uses, for the treatment of all resource concerns for soil, water, air, plants, and animals that meets or exceeds the quality criteria in the Field Office Technical Guide (FOTG) for resource sustainability."

[145] NRCS GENERAL MANUAL, Title 180, Part 409, § 409.1(a)(1).

[146] *Id.* § 409.1(a)(2). *See also infra* text at note 295 (explaining that to earn CSP payments, producers must achieve an additional conservation threshold for a resource concern within the contract period).

[147] NPPH, *supra* note 118, at § 600.5 (comprehensive nutrient management plans).

[148] *Id.* at § 600.6, Subpart F, Exhibit 3 (special environmental concerns).

[149] NRCS GENERAL MANUAL, Title 180, Part 409, § 409.1(b).

[150] *Id.* § 409.1(c); NPPH, *supra* note 118, at § 600.10; *See generally* NRCS MANUAL, Title 440, Part 518, § 518.13 (describing the contribution of conservation districts to planning, including:

> (i) Assess natural resource conditions and needs;
> (ii) Identify local natural resource priorities and available resources;
> (iii) Convene the local work group(s) impacted by the selected watershed(s);
> (iv) Provide input and recommendations to NRCS for CSP guidelines;
> (v) Provide technical assistance, where appropriate;
> (vi) Assist NRCS with information and outreach programs;
> (vii) Recommend criteria for enhancement activity payments;
> (viii) In carrying out the role of contract violations and terminations, the State Conservationist may consult with the local conservation district; and
> (ix) Other mutually agreed to responsibilities as requested).

Local work groups also advice NRCS on implementation of conservation measures. *Id.* §518.15; NRCS MANUAL, Title 440, Part 500 (locally lead conservation).

[151] NPPH, *supra* note 118, at § 600.10. The NPPH states that:

> The term "stewardship" has been used since the beginning of the conservation movement. Webster defines stewardship as "the individual's responsibility to his life and property with proper regard to the rights of others." In this sense, stewardship implies that landowners view their actions in terms of how they affect their neighbors, their grandchildren, and all those that might be influenced by their production and conservation decisions. Seen in this light, stewardship is about being responsible. It is about changing attitudes, forging local shared visions of the desired state for private and public natural resources, and facilitating the actions needed to realize the desired future condition. Institutionally, stewardship is about assisting land users to care for the resources.

Id. at § 600.46(e).

[152] *Id.* § 600.11.

[153] Areawide assessments or plans can be conducted by informal or formal groups of local landowners and a wide variety of other organizations, including irrigation and watershed districts. *Id.* § 600.11(d).

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operations, and sub-units.[154] The entire individual planning process covers, in addition to a preplanning process,[155] three phases and a total of nine steps.[156] The result is a conservation plan, which NRCS describes as:

> . . .voluntary, site-specific, comprehensive, and action oriented. A conservation plan contains natural resource information and a record of decisions made by the client. It describes the schedule of operations and activities needed to solve identified natural resource problems and take advantage of opportunities. Using the planning process to develop conservation plans helps ensure that the needs of the client and the resources will be met, and that federal, state, and local requirements will be achieved.[157]

During phase I, the producer identifies resource problems/conditions and production objectives, and analyzes existing information about the resources at issue.[158] Sources of information available to the producer include data from on-site evaluations, area-wide assessments or plans, external sources such as universities, and NRCS resources such as soil surveys,[159] manuals, handbooks and FOTG.[160] Local Conservation District preferences and resources also are identified.[161] Resource problems or conditions include those related to soil quality and quantity (e.g., erosion, condition, deposition), surface and ground water quality and quantity, air quality, plant-specific conditions (diversity loss, noxious or invasive weeds, endangered species, pest infestation, deforestation), animals (wetland and other habitat quality), and human social and economic conditions.[162] The producer also may apply tools to determine whether a potential erosion problem exists.[163]

Based on the assessment, the producer then formulates, evaluates, and chooses from alternative actions to remedy resource problems.[164] NRCS recommends alternatives that span "[a] broad range of technically feasible alternatives. . . including an appropriate mix of structural measures. . . non-structural measures such as crop residue management, livestock exclusion, and flood-proofing; market-based measures such as cost-sharing, easements, and local tax incentives; and institutional measures such as zoning or local regulations, and state and federal laws and regulations."[165] Plans must evaluate alternative practices not in isolation, but instead must be "aware of the effects on all resources."[166] Phase III concludes with plan implementation and evaluation.[167] Producer evaluation provides important feedback so that the producer and NRCS

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[154] *Id.* § 600.11.
[155] *Id.* § 600.13.
[156] *Id.* §§ 600.13; 600.20.
[157] *Id.* § 600.11(c).
[158] *Id.* § 600.20.
[159] NRCS also determines whether the land is subject to highly erodible lands (HEL) requirements. *See supra* note 101. The CSP contract requires the Producer to submit From AD-1026, which certifies that the requirements for highly erodible land and wetland conservation are met. *See* NRCS-CPA-1201-CPC (appendix).
[160] *Id.* §§ 600.21, 600.40. Detailed inventory methods for each resource concern are contained in the National Agronomy Manual, *supra* note 100.
[161] NPPH, *supra* note 118, at § 600.10.
[162] *Id.* at Part 600, Part F, Exhibit 1 (Sample Resources Checklist).
[163] *Id.* at § 600.24; *see also infra* text and notes at XX (RUSLE2 and WEQ erosion prediction tools).
[164] NPPH, *supra* note 118, at § 600.24.
[165] *Id.* at § 600.26.
[166] *Id.* at § 600.41. As an example, NRCS state that its "involvement with water quality has brought this reality to the forefront, as has the public's growing concern for the environment, especially wetland protection, food and water safety, fish and wildlife protection and enhancement, and a sustainable agriculture." *Id.*
[167] *Id.*

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can adjust quality criteria or practices.[168] Evaluation can include a case study of a practice or set of practices from a given site, which can play an important role in building FOTG.[169] The completed conservation plan is contained in an NRCS case file, along with supporting documents.[170] The producer has parallel obligations during the planning process, such as NEPA and Endangered Species Act compliance.[171]

B. Tools for Estimating Biomass Sustainability

Several tools–many of which are implicated in conservation planning–can assist producers in determining whether their practices meet the NRCS quality criteria for a given resource concern. Predictive models and direct measurement tools can estimate the environmental effects of agricultural practices on soil, water and air, which in turn can inform greatly the alternatives considered during the planning process. In addition to whole farm measurements, models and assessment tools also are capable of gauging more macro-level impacts.

This article does not attempt to discuss all models and tools, as there are many worldwide in existence and in development. Instead, the following discussion centers on models used in conservation planning by NRCS and conservation districts that could be used in conservation planning within energy biomass standards.

1. Soils

Soil surveys provide the fundamental understanding of soil properties and qualities necessary to conservation planning and ultimately improving water, soil and air quality, and increasing biodiversity.[172] A soil survey "describes the characteristics of the soils in a given area, classifies the soils according to a standard system of classification, plots the boundaries of the soils on a map, and makes predictions about the behavior of soils."[173] The NRCS' National Soil Survey Handbook (NSSH) sets the standards, guidelines, and criteria for conducting the National Cooperative Soil Survey.[174] The Soil Survey Manual details the principles and practices soil scientists use on the ground in classifying and mapping soils.[175] A soil survey can provide producers with information regarding differences in soils and environmental features that influence their use, management and behavior, such as soil type/taxonomy, structure, productivity, erosion, drainage/infiltration, temperature, animal presence, chemical properties

[168] *Id.* at § 600.29.
[169] *Id.* at § 600.42.
[170] *Id.* at §§ 600.28, 600.31 (detailing the format and constituent parts of the individual conservation plan); 600.32 (detailing the format and constituent parts of the areawide conservation plan).
[171] *Id.* at 600-A-11-5; 600-D-45-1 - 600-D-45-2; NRCS GENERAL MANUAL Part 410, Compliance with NEPA, § 410.22(b).
[172] Soil Survey Manual, *infra* note 175, at Chapter 1, p. 10; Chapter 4, pp. 1-2.
[173] *Id.*, Chapter 1, p. 2.
[174] NRCS, Title 430, National Soil Survey Handbook at § 600.00, *available at* http://soils.usda.gov/technical/handbook/download.html. The USDA, in conjunction with either the state's agricultural experiment station or land grant university, conducts the Nation Cooperative Soil Survey. Soil Survey Manual, *infra* note 175, at Chapter 1 p. 1. The federal mandate to conduct such surveys dates back to 1896. *Id.*
[175] NRCS, Soil Survey Manual (1994), available at ftp://ftp-fc.sc.egov.usda.gov/NSSC/Soil_Survey_Manual/pdf/SSM.pdf [hereinafter Soil Survey Manual].

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(such as pH and salinity).[176] Soil scientists also gather information not directly related to soils, including land-use patterns and plans in the mapping area, ownership patterns, mineral and water rights, cultural/economic/social factors that influence land use, and other unique climate or soil-related characteristics of the area.[177] NRCS houses soil survey information in a computerized database.[178]

NRCS has identified soil erosion[179] and soil condition (organic matter depletion, compaction, contaminants) as resource concerns.[180] For each of these concerns, national and state quality criteria exist that may require, for example, a certain score on a soils modeling tool, specific management practices (such as controlling runoff and monitoring chemical and fertilizer application (e.g., soil and plant tissue tests, application records, Farm*A*syst assessment[181])), and/or following NRCS guidance specific to the practice (e.g., irrigation).

a. The Revised Universal Soil Loss Equation, Version 2 (RUSLE2)

The Revised Universal Soil Loss Equation, Version 2 (RUSLE2) is NRCS's official modeling tool for predicting soil loss due to water erosion.[182] In its current form, RUSLE2 exists as a downloadable computer program[183] that allows its user to estimate the average annual soil loss resulting from erosion on a given piece of land. In general terms, RUSLE2 estimates annual soil loss based on a consideration of "climate, soil properties, topography, vegetative cover, and conservation practices."[184] While it has undergone substantial revisions,[185] RUSLE2 is fundamentally based on the original Universal Soil Loss Equation (USLE), which was first formulated in 1965.[186] USLE calculated average annual soil loss on a given piece of land as the product of six unique factors: (1) rainfall and runoff erosivity[187] (i.e., climate properties); (2) soil

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[176] *Id.* at Chapter 2, p. 13; *see generally* Chapter 3.
[177] *Id.* at Chapter 4, pp. 15-16.
[178] *Id.* at Chapter 7, p. 12-13.
[179] For a detailed description of soil erosion, see the Soil Survey Manual, *supra* note 175, Chap. 3 at 17.
[180] *See e.g.*, NRCS, *Soil Quality Information Sheet, Soil Quality Resource Concerns: Soil Erosion* (Apr. 1996), *available at* http://soils.usda.gov/sqi/publications/files/sq_two_1.pdf; NRCS, Soil Quality Technical Note No. 5, *Managing Soil Organic Matter: The Key to Air and Water Quality* (Oct. 2003), http://soils.usda.gov/sqi/concepts/soil_organic_matter/files/sq_tn_5.pdf.
[181] The Farm*A*Syst Program is "a partnership between government agencies and private businesses that enables [the producer] to prevent pollution on farms, ranches, and in homes using confidential environmental assessments" of issues such as: quality of well water, new wells, and abandoned wells; livestock waste storage; storage and handling of petroleum products; managing hazardous wastes; and nutrient management. Farm*A*SystHome*A*Syst, Environmental Resources Center, The University of Wisconsin, http://www.uwex.edu/farmasyst/ (last visited X).
[182] NAM, *supra* note 100, § 501.20.
[183] NRCS's official version of RUSLE2 is available for free download at http://fargo.nserl.purdue.edu/rusle2_dataweb/RUSLE2_Index.htm.
[184] *Id.* at § 501.40. "Erosion" is categorized as rill or interrill. Rill erosion occurs as runoff water dislodges and transports soil particles by way of rills. NRCS defines a rill as "[a] small, intermittent water course with steep sides; usually only several centimeters deep." NAM, *supra* note 100, Glossary. NRCS defines interrill erosion (sometimes referred to as sheet erosion) as "the detachment of soil particles by raindrop impact and the removal of thin layers of soil from the land surface by the action of rainfall and runoff." *Id.* § 501.10.
[185] For a detailed account of RUSLE2's evolution, *see id.* at § 501.21. *See also* RUSLE2 USERS GUIDE, at 7, *available at* http://fargo.nserl.purdue.edu/rusle2_dataweb/userguide/RUSLE2-2-3-03.pdf.
[186] NAM, *supra* note 100, at § 501.21
[187] NRCS defines erosivity as "[t]he energy (amount) and intensity of rainstorms that cause soil to erode. Erosivity includes the effects of raindrop impact on the soil and the amount and rate of runoff likely to be associated with the

erodibility[188] (i.e., soil properties); (3) slope length (i.e., a topographical feature).[189] (4) slope steepness (i.e., a topographical feature); (5) cover management practices; and (6) supporting practices (i.e., conservation practices).[190] The current version is utilizes a graphical interface and accompany databases that contain baseline, climate and soils data, and crop management templates.[191]

Although not fully developed at present, the cover management and supporting practices factors in the RUSLE 2 equation will be significant determinants of the conservation benefits of energy biomass cropping over other crops and practices. The cover management factor compares the difference between an area with a specified cover management practice to one that is cultivated continuously.[192] Similarly, the supporting practices factor compares the soil loss resulting from a more innovative support practice like contouring, strip cropping, or terracing with soil loss associated with straight-row farming up and down the slope.[193] Manipulation of these two factors is the primary way in which RUSLE2 can compare the effects of different management and practices options in conservation planning.[194]

For conservation planning purposes, the average annual soil loss predicted by RUSLE2 is used in two distinct ways.[195] First, it can be compared against alternate scenarios created in the RUSLE2 Program to advise conservation planning decisions.[196] Second, it can be used to compare the outputted average annual soil loss to the predetermined soil loss tolerance value

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rainfall event." *Id.* at Glossary. The rainfall and runoff erosivity factor represents "the average annual total of the storm energy and intensity values in a given location." *Id.* at § 501.31.

[188] NRCS defines erodibility as "[t]he susceptibility of soil to erosion. For water erosion, soils with low erodibility include fine textured soils high in clay that are resistant to detachment, and coarse textured soils high in sand that have low runoff. Soils having a high silt content are highly susceptible to erosion." *Id.* The soil erodibility factor is a metric that represents the standard erodibility of a unit plot, which is defined as "an erosion plot 72.6 feet . . . long on a 9 percent slope, maintained in continuous fallow, tilled up and down hill periodically to control weeds and break crusts that form on the soil surface." *Id.* at § 501.32. NRCS determines the value for this factor based on long-term data from the National Weather Service, *id.* at § 501.25, and for a given piece of land, different soil properties such as "texture, structure, permeability and organic matter content." P.I.A. Kinnell, *Event Soil Loss, Runoff and the Universal Soil Loss Equation Family of Models: A Review*, 385 J. HYDROLOGY 384-397 (2010). The combination of these factors represents the ratio of soil loss from a given piece of land (based on the actual field measurements) to the soil loss from the standard unit plot. NAM, *supra* note 100, at § 501.32. Based on field tests throughout different geographical areas, NRCS maintains a database of the proper values to choose from in RUSLE2 for the soil erodibility factor. *Id.*

[189] The slope length and steepness factors are determined for each unique piece of land based on field measurements. *Id.* at § 501.33. Essentially, the slope length is defined as the distance from where soil erosion begins to the location where the displaced soil is deposited. Kinnell, *supra* note X. The slope steepness of a given plot is determined in the field through he use of "a clinometer, Abney level or similar devise." *Id.*

[190] National Agronomy Manual, *supra* note X, at § 501.21. In algebraic terms, USLE is often stated as "A = R K L S C P" where "A is average (mean) annual soil loss (mass/area/year) over the long term (e.g., 20 years), R is the rainfall–runoff 'erosivity' factor, K is the soil 'erodibility' factor, L and S are the topographic factors that depend on slope length and gradient, C is the crop and crop management factor, and P is the soil conservation practice factor." Kinnell, *supra* note 188, at 385.

[191] Revised Universal Soil Loss Equation, Version 2, http://fargo.nserl.purdue.edu/rusle2_dataweb/RUSLE2_Index.htm (last visited March 3, 2010); *see generally*, RUSLE2 – INSTRUCTIONS & USER GUIDE, *available at* http://fargo.nserl.purdue.edu/rusle2_dataweb/userguide/RUSLE2%20Program%20Users%20Guide.pdf.

[192] NAM, *supra* note 100, at § 501.34.

[193] *Id.* at § 501.35.

[194] *Id.*

[195] National Agronomy Manual, *supra* note 1, at § 501.20.

[196] *Id.* at § 501.41.

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(usually referred to as "T")[197] to determine if existing farming practices can meet a level of conservation.[198] If the average annual soil loss outputted by the RUSLE2 Program for a given field is equal to or less than the relevant T value, then the landowner is considered to be utilizing its soil in a sustainable manner.[199] If the landowner's average annual soil loss is greater than the relevant T value, then the landowner utilizes the RUSLE2 Program (in the above described manner) to determine what alternative farming practices might be implemented to produce an average annual soil loss that is less than or equal to the relevant T value.[200]

b. The Soil Conditioning Index

Although its origins date back to 1964,[201] the Soil Conditioning Index (SCI) emerged as an important qualitative tool in the NRCS planning arsenal as it expanded its planning focus in the early 1990s beyond erosion to a more holistic consideration of soil, air, water, plant and animal.[202] The SCI measures soil organic matter (SOM), which includes "living biomass of microorganisms, fresh and partially decomposed residues, and well-decomposed and highly stable organic matter."[203] SOM is one indicia of sustainable practices because, among other things, increased SOM boosts soil productivity, cycles nutrients, and buffers against water pollution.[204] SOM also encourages cation exchange,[205] soil stability, the ability to hold water, and soil biological activity.[206]

Different management practices can negatively affect SOM. Excess erosion leads to loss of valuable soil nutrients, particles and matter.[207] Tillage practices can result in accelerated organic matter decay.[208] Certain crops and harvest practices can reduce field residues.[209] The producer can input the operation's practices into the SCI tool during the planning process to determine whether the operation will lead to increased, decreased or maintained SOM.[210] The SCI qualitatively measures biomass cycled through the soil (whether from within or outside the

[197] The National Soil Survey Manual, *supra* note 175, defines "T" as "the maximum rate of annual soil erosion that will permit crop productivity to be sustained economically and indefinitely. The T factors are integer values of from 1 through 5 tons per acre per year. The factor of 1 ton per acre per year is for shallow or otherwise fragile soils and 5 tons per acre per year is for deep soils that are least subject to damage by erosion."
[198] National Agronomy Manual, *supra* note 1, at § 501.20.
[199] *Id.*
[200] *Id.*
[201] The values included in the SCI for several of the variables are derived from field studies conducted decades ago at Renner, TX. See NRCS, GUIDE TO USING THE SOIL CONDITIONING INDEX 8 (Oct. 2002), ftp://ftp-fc.sc.egov.usda.gov/SQI/web/SCIguide.pdf (last visited X).
[202] NAM, *supra* note 100, at § 508.30(c).
[203] NRCS SOIL QUALITY GLOSSARY, http://soils.usda.gov/sqi/concepts/glossary.html (last visited X); NAM, *supra* note 100, at § 508.30(c). Surface litter is generally not included as part of soil organic matter." *Id.*
[204] NATIONAL RESOURCE CONSERVATION SERVICE, SOIL QUALITY – AGRONOMY TECHNICAL NOTE NO. 16, INTERPRETING THE SOIL CONDITIONING INDEX: A TOOL FOR MEASURING SOIL ORGANIC MATTER TRENDS 1 (2003), http://soils.usda.gov/sqi/management/files/sq_atn_16.pdf (last visited X).
[205] Soils with low cation exchange, which include some soil nutrients, require more fertilizer and other amendments. National Soil Survey Handbook, *supra* note 174, at §618.18.
[206] NAM, *supra* note 100, at § 508.30(e).
[207] *Id.* at § 508.30(d).
[208] *Id.*
[209] *Id.*
[210] *Id.* § 508.30(c).

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farm gate), the effects of tillage and inputs, and erosion.[211] The model assumes that equilibrium is only achieved if biomass is returned to the soil at the same rate it decays, which depends in part on temperature and moisture measurements throughout the U.S. that are incorporated in the model's database.[212]

If the SCI value outputted after a user runs the RUSLE2 Program based on its existing practices is zero or positive, the user is considered to be managing its soil organic matter content in a sustainable manner.[213] On the other hand, if this SCI value is negative, the user is considered to not be managing its soil organic matter content in a sustainable way and he or she should determine what corrective measures it could possibly take.[214] Essentially, the user creates alternate runs of the RUSLE2 Program where it inputs alternate farming practices to determine which alternatives might result in a positive SCI value. Based on these alternate runs, the user can then formulate a conservation plan that will potentially result in the sustainable maintenance of its soil organic matter content.

The research underlying the SCI tabular values for soil disturbance (field mechanical practices associated with planting, upkeep, and harvesting), organic matter maintenance amounts and residue equivalence values, and even erosion values appear not to include data specific to energy biomass cropping. It does appear, however, that the SCI can take into account corn stover removal. This is important, as economic drivers could result in harvesting of energy biomass residues in excesses that diminish soil organic matter, and require artificial inputs to replenish nutrients.

2. Management of Noxious/Invasive Plants[215]

NRCS defines noxious weeds as "possess[ing] one or more of the characteristics of being aggressive and difficult to manage, parasitic, a carrier or host of serious insects or disease, and being native or new to or not common to the United States or parts thereof."[216] NRCS'

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[211] *Id.* The SCI uses crop databases, in addition to calculations related to cropping and harvesting practices, to measure the root mass of the selected crop in order to determine the amount of organic matter in the top four inches of soil. *Id.* § 508.32(b)(1)(iii). Once the SCI calculates the organic matter "budget" for the year, it compares it to an equivalence value for decay of various residues ("residue equivalence value" or "REV"), to arrive at a value for organic matter. *Id.* § 508.32(c)-(d). The second variable in the SCI equation involves calculation of a value for field operations' disturbance on the soil and the resulting effects on organic matter over multi-year cultivation periods. *Id.* § 508.33. The SCI terms this value the "soil disturbance rating" (SDR). The values are based on typical practices associated with commodity crops. The third SCI value, erosion, is based on a RUSLE2 calculation. *Id.* § 508.34(a).

All three values ("subfactors") in the SCI (organic matter, field operations, and erosion) are weighted 40-40-20. *Id.* § 508.35. Each subfactor is assigned a subjective value from -1 to 1 based on complex formulae and comparisons to a benchmark condition. If the information inputted into the RUSLE2 Program relevant to a given subfactor is considered to result in maintaining soil organic matter at equilibrium, the subfactor is assigned a value of 0. A positive value for the subfactor is assigned if this information is considered to result in an increase of soil organic matter and a negative value is assigned if the information is considered to result in a decrease of soil organic matter. For a detailed explanation of the complex methodology underlying SCI, *see id.* § 508.35.

[212] *Id.* § 508.30(c).

[213] NAM, supra note 100, at § 508.36(b).

[214] *Id.*

[215] NRCS, GENERAL MANUAL, Title 190, Part 414.

[216] USDA, Departmental Regulation Number 9500-10, *Policy of Noxious Weed Management* at 4, *available at* http://www.fsa.usda.gov/Internet/FSA_File/dr9500-010.pdf [hereinafter USDA Noxious Weed Policy]. The National Invasive Species Advisory Committee, http://www.invasivespecies.gov/global/ISAC/ISAC_index.html,

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invasiveness policy is based on President Clinton's 1993 Executive Order 13112[217] to prevent the introduction, and the control of, invasive species, and subsequent policy set by the National Invasive Species Council (NISC) and Invasive Species Advisory Committee (ISAC) created as a result of the Order.[218] NISC and ISAC created a National Invasive Species Management Plan (NISMP), which, in conjunction with USDA policy for noxious weed management, guides NRCS policy.[219] NRCS maintains an invasive and noxious weed list, and is responsible in the NISMP for preventing introduction of noxious/invasive species, and developing best management practices.[220]

NRCS states that its role in invasive species management, among others, is to encourage the use of native species, or where conservation goals demand, non-natives.[221] Invasive species management is an integral part of NRCS planning.[222] NRCS will not recommend for inclusion in a conservation plan any invasive species on county, state, or Federal lists, and it considers eradication/control efforts' effect on natural resources.[223] These management considerations will be key in acceptance of bioenergy cropping, particularly those that have met with skepticism regarding their invasiveness potential.

3. Carbon Sequestration and Emissions Modeling

The Carbon Management Online Tool for Voluntary Reporting (COMET-VR) estimates the amount of carbon that is stored or sequestered in soil, depending on land management practices.[224] The tool, which is available online for free, public use,[225] is the product of collaborative efforts between NRCS and Colorado State University's Natural Resource Ecology Lab (CSU NREL).[226] Currently, COMET-VR is the official tool for estimating soil carbon sequestration for both the Department of Energy's (DOE) Voluntary Reporting of Greenhouse Gases Program[227] and USDA's Conservation Stewardship Program (CSP).[228]

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basically defines noxious and invasiveness similarly. *See* National Invasive Species Management Plan, *infra* note 219, at 7.

[217] White House, Executive Order 13112 (Feb. 3, 1999), *available at* http://www.invasivespecies.gov/home_documents/EO%2013112.pdf.

[218] NRCS, GENERAL MANUAL, *supra* note 215, at § 414.1.

[219] *Id. See also* USDA Noxious Weed Policy, *supra* note 216; NATIONAL INVASIVE SPECIES COUNCIL, 2008-2012 NATIONAL INVASIVE SPECIES MANAGEMENT PLAN (Aug. 2008), *available at* http://www.invasivespecies.gov/home_documents/2008-2012%20National%20Invasive%20Species%20Management%20Plan.pdf.

[220] *Id.*; NRCS, *Invasive and Noxious Weeds*, http://plants.usda.gov/java/noxiousDriver (last visited X).

[221] NRCS, General Manual, *supra* note 215, at § 414.11(4)-(5). Despite this policy, however, NRCS has allowed millions of acres of CRP land to be planted with non-natives. *See* MEAGAN MCLACHLAN & MIKE CARTER, EFFECTS OF THE CONSERVATION RESERVE PROGRAM ON PRIORITY SHORTGRASS PRAIRIE BIRDS: A CONSERVATION EFFECTS ASSESSMENT PROJECT (CEAP) at 14 (Jun. 2009), *available at* ftp://ftp-fc.sc.egov.usda.gov/NHQ/nri/ceap/PLJV_BCR18_CEAP_report_090630.pdf (noting that the majority of CRP lands are planted in non-native grasses).

[222] NRCS, GENERAL MANUAL, *supra* note 215, at § 414.30(A).

[223] *Id.* § 414.30(A)-(B).

[224] *Global Climate Change, NRCS Soils*, *available at* http://soils.usda.gov/survey/global_climate_change.html.

[225] *Online Tool for Agriculture & Range, Version 1.1*, *available at* http://www.cometvr.colostate.edu/tool/default.asp?action=1.

[226] *Welcome to the Voluntary Reporting Carbon Management Online Tool for Agriculture and AgroForestry Version: 1.0*, http://www.cometvr.colostate.edu/ (last visited X) [hereinafter CometVR Online Tool].

[227] OFFICE OF POLICY & INTERNATIONAL AFFAIRS UNITED STATES DEPARTMENT OF ENERGY, TECHNICAL GUIDELINES VOLUNTARY REPORTING OF GREENHOUSE GASES (1605(B)) PROGRAM (2007), *available at*

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COMET-VR exists as an online interface for landowners to determine their soil's annual carbon flux based on simulations created by the CENTURY model.[229] The CENTURY model, also developed and maintained by CSU NREL, generally simulates SOM dynamics in relation to management practices and climate, within different types of ecosystems including grasslands, agricultural lands, forests and savannas.[230] CENTURY utilizes several unique modules, including: a soil organic matter/decomposition sub-model, a water budget model, a grassland/crop sub-model, a forest production sub-model, and management and events scheduling functions.[231] CENTURY also computes sulfur, phosphorus, nitrogen, and carbon fluxes within each module.[232]

Producers first input land characteristics into COMET-VR, including the location, type, and size of the operation, surface soil texture,[233] and whether or not the soil is hydric.[234] Management practices reporting, including cropping and tillage,[235] is divided into four time periods: (1) circa 1880 to 1970; (2) 1970s through mid-1990s; (3) current management;[236] and, (4) the Report Period.[237] After the user inputs all of this information, COMET-VR generates (through the application of the CENTURY model) a "Carbon Storage Report" that predicts the change in soil carbon for the given parcel (expressed as total tons of carbon stored per year and total tons of CO2 equivalent per year stored).[238] The model also calculates the average diesel fuel used for tillage and nitrogen use for both the current management and Report periods.[239] For conservation planning purposes, COMET-VR is used in a manner similar to RUSLE2,[240] although it is not yet integrated into the suite of NRCS online tools. Producers can test

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http://www.eia.doe.gov/oiaf/1605/January2007_1605bTechnicalGuidelines.pdf. The Voluntary Reporting of Greenhouse Gases Program was established by § 1605 of the Energy Policy Act of 1992, Pub. L. No. 102-486, 106 Stat. 2776.

[228] NRCS, *CSP Worksheet*, http://www.mn.nrcs.usda.gov/programs/csp/2006/jobsheets/air/COMET-VR_Enhancement.pdf (last visited X).

[229] CometVR Online Tool, *supra* note 226.

[230] CENTURY, http://www.nrel.colostate.edu/projects/century/ (last visited X).

[231] *Id.*

[232] *Id.* For a detailed account of how the Century model operates, *see* CENTURY MANUAL, *available at* http://www.nrel.colostate.edu/projects/century/.

[233] Users have the option of selecting clay, clay loam, loam, loamy sand, sand, sandy clay, sandy clay loam, sandy loam, silt, silt loam, silt clay, or silty clay loam. *Id.* For a detailed explanation of these different soil surface textures, *see* Help: Soil Information, *available at* http://www.cometvr.colostate.edu/Help/soilInformation.asp.

[234] In making the determination of whether the soil is "hydric," the COMET-VR instructs that:

> [a] hydric soil develops under moderate to poor drainage conditions. Soils that were frequently ponded or saturated from flooding during a significant portion of the year are most often classified as 'hydric' soils. This means that some or all of the surface soil was anaerobic (i.e., oxygen is virtually absent from the soil) for some portion of the year. If the surface soil in your parcel has been tile drained, consider it to be hydric.

Id.

[235] Users must select between intensive, reduced, or no-till tillage. No till tillage is defined as "planting and injection of fertilizer as the only soil disturbance in the rotation or the use of strip tillage where only the surface area being planted is disturbed. This type of tillage would result in >30% residue cover at planting." *Id.*

[236] Current management "refers to the cropping rotation that most accurately describes the cropping or grazing system used on the parcel over approximately the last decade." *Id.*

[237] The report period "refers to the crop rotation or grazing system that you either use or are considering using on the parcel for the reporting period (the next decade)." *Id. See also Online Tool for Agriculture & Range, Version 1.1*, http://www.cometvr.colostate.edu/tool/default.asp?action=1 (last visited X).

[238] *Id.*

[239] *Id.*

[240] *See supra* Part III.B.1.a.

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management and tillage practices using the model to determine which will result in the greater rate of soil carbon storage. Scientists currently are working on other models that provide more individualized measures based on localized conditions, such as C-Farm[241] and CQESTR.[242]

4. Water Quality[243]

Energy biomass cropping can offer solutions to water quality problems in watersheds surrounded by agricultural production, except in cases when excess residue removal causes soil erosion, or agrochemical application decreases biodiversity and harms water quality. NRCS maintains special procedures to identify agricultural sources of non-point pollution, and once identified, incorporates management practices into new or existing conservation planning. NRCS water quality data collection also can inform other modeling efforts, whether at the farm, watershed, regional, or national level.

a. The NRCS National Water Quality Handbook

NRCS maintains a National Water Quality Handbook to guide personnel in assessing and monitoring water quality concerns,[244] to incorporate management practices into producer conservation plans, and implement practices that address agricultural non-point sources of pollution.[245] NRCS, in conjunction with local and state authorities, conduct monitoring to analyze trends in water quality, and to isolate both sources and targets of pollutants.[246] NRCS can then devise Resource Management Systems where water pollution is of greatest concern.[247] NRCS also uses water quality monitoring to ensure compliance with programmatic conservation requirements, allocate conservation practices within a watershed, and evaluate program effectiveness.[248] In addition, NRCS water quality monitoring provides critical data to longer-term modeling of watershed water quality,[249] such as SWAT.[250]

Once a water quality concern is identified, NRCS designs a monitoring plan by setting objectives, statistical approaches, scale of the study, the variables to be measured (e.g., turbidity, suspended solids, phosphorus, nitrogen, pH, fish populations), the method samples are taken, sampling locations, and sampling frequency and duration.[251] NRCS then conducts both water

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[241] Armen R. Kamanien & Claudio O. Stöckle, *C-Farm: a simple model to evaluate the carbon balance of soil profiles*, 32 EUR. J. AGRONOMY 22-29 (2010).
[242] Agric. Research Serv., CQESTR, http://www.ars.usda.gov/Research/docs.htm?docid=13499 (last visited X).
[243] NRCS, NATIONAL WATER QUALITY HANDBOOK at 1-2 (Sept. 2003), *available at* http://www.wsi.nrcs.usda.gov/products/W2Q/water_qual/docs/NatWQhandbookNRCS.pdf (defining water quality as "the physical, chemical, and biological composition of water as related to its intended use for such purposes as drinking, recreation, irrigation, and fisheries).
[244] *Id.* at 2-1 (providing a table of water quality symptoms and problems).
[245] *Id.* at 1-1.
[246] *Id.* at 1-2 – 1-3.
[247] *Id.* at 1-3.
[248] *Id.*
[249] *Id.* at 1-4. NRCS admits, however, that "[a] major difficulty in model validation is that many models are developed to simulate long-term average conditions; whereas, most monitoring data are collected on a relatively short-term basis. In addition, many of the input variables used in a model, such as the hydraulic conductivity or wind speed, typically are not monitored." *Id.*
[250] *See infra* Part III.B.4.b.
[251] NRCS NATIONAL WATER QUALITY HANDBOOK, *supra* note 243, at 1-7 -1-9.

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quality and land use management practices monitoring simultaneously, and analyzes the results.[252] Monitoring is designed to discover causality between an agricultural management practice and the water quality problem.[253] NRCS uses statistical analysis to pinpoint pollution sources.[254]

In addition to the Water Quality Handbook, NRCS maintains national conservation practice standards for pest and nutrient management that includes provisions for protection of water quality such as assessing risks.[255] Producers must devise nutrient budgets as part of the management plan.[256] NRCS's Handbook for Comprehensive Nutrient Management Planning details the process for NRCS personnel to follow.[257] Several tools are available in relation to manure and other nutrient assessment and management.[258]

Two of the risk assessment tools referenced in the pest management practice standard are the Windows Pesticide Screening Tool (WIN-PST) and the National Agricultural Pesticide Risk Assessment (NAPRA) tool.[259] Producers can use the WIN-PST software to calculate the environmental risk created by their operation's pest management strategy (e.g., insects and weeds), including to water quality.[260] The producer can chose, in the interactive tool, various variables related to the soil, cropping, and erosion characteristics of the operation, rainfall, and the specific pest control measure(s) applied. The computerized tool generates two reports: (2) a rating of soil sensitivity to pesticide loss from leaching and runoff; and (2) a pesticide active ingredient rating for runoff/leaching and toxicity. If the assessment tools conclude that the risk of water contamination is high, the producer must incorporate mitigation techniques such as filter strips and tillage timing into the conservation management plan.[261] The national conservation practice standard for pest management requires integrated pest management (IPM) to reduce overall environmental risks.[262]

b. The Soil and Water Assessment Tool (SWAT)

The USDA currently uses the Soil and Water Assessment Tool (SWAT) to gauge the effectiveness of various agricultural conservation practices to reduce non-point source pollution

[252] *Id.* at 1-12.
[253] *Id.* at 12-7; Part 615.05.
[254] *Id.* Part 615.
[255] NRCS, NATIONAL CONSERVATION MANAGEMENT PRACTICE STANDARD, NUTRIENT MANAGEMENT (590) (Aug. 2006), *available at* ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/590.pdf [hereinafter Practice Standard 590]; NRCS National Conservation Practice Standard, Pest Management (595) (Jul. 2008) at 595-2, ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/595.pdf [hereinafter Practice Standard 595].
[256] Practice Standard 590, *supra* note 255, at 590-1.
[257] NRCS HANDBOOK, TITLE 190, PART 620, SUBPART B, COMPREHENSIVE NUTRIENT MANAGEMENT PLANNING.
[258] *Id.* These include soil tests that comply with state regulation and/or technical protocol.
[259] For an analysis of how the tools are applied to corn ethanol production, *see* Mark A. Thomas, *et al.*, *Water Quality Impacts of Corn Production to Meet Biofuels Demands*, 135 J. ENVTL. ENG. 1123-1135 (Nov. 2009).
[260] Windows Pesticide Screening Tool (WIN-PST 3.1), http://www.wsi.nrcs.usda.gov/products/w2q/pest/winpst31.html (last visited X); WIN-PST 3.1 User Help at 1, http://www.wsi.nrcs.usda.gov/products/w2q/pest/docs/WIN-PST_3.1_User_Help.pdf (last visited X).
[261] Practice Standard 595, *supra* note 255, at 595-2; *see also* NRCS, *Table 1—Mitigation Effectiveness Guide-Reducing Pesticide Impacts on Water Quality*, *available at* http://www.wsi.nrcs.usda.gov/products/w2q/pest/pmPolicy.html.
[262] Practice Standard 595, *supra* note 255, at 595-1.

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in large, complex watersheds as part of the Conservation Effects Assessment Project (CEAP).[263] SWAT contains many modules that simulate cropping and management practices on different soils and their effects on water quality, sediment, and "chemical yields."[264] Scientists have used the model to evaluate best management practices related to pollutant losses from such practices as "fertilizer and manure application rate and timing, cover crops (perennial grasses), filter strips, conservation tillage, irrigation management, flood-prevention structures, grassed waterways, and wetlands."[265] Although the model is not used at the individual producer level, the model can be useful to policymakers designing sustainability regimes for biomass to the extent it can simulate energy biomass cropping practices in aggregate within a watershed.

The Agricultural Policy Environmental EXtender (APEX) bridges the gap between The Environmental Policy Impact Climate (EPIC)[266] and SWAT models by providing a means to calculate agricultural management practices on whole farms and small watersheds.[267] Modelers predict that APEX modeling, embedded within SWAT, will provide the "multi-subarea capabilities" in the future to evaluate "different cropping systems and conservation practices on varied landscapes."[268] Indeed, meeting the challenge of valuing complex ecosystems[269] through modeling will better enable energy biomass cropping to meet sustainability standards, whether in regulations or in emerging markets for ecosystem services.

5. Biodiversity

Biological diversity ("biodiversity") "is the variety of all these living things and their interactions."[270] NRCS' National Biodiversity Handbook (NBH) examines fish and wildlife habitats and devises ways, through the National Conservation Partnership, in which to incorporate biodiversity considerations into conservation management planning.[271] While the

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[263] Soil & Water Assessment Tool (SWAT), available at http://swatmodel.tamu.edu/; P.W. Gassman, *et al.*, *The Soil and Water Assessment Tool: Historical Development, Applications, and Future Research Directions*, 50 ASABE 1211, 1215 (2007). *See also infra* note 353 (CEAP).

[264] Gassman, *et al.*, *supra* note 262, at 1213; S.L. Neitsch, *et al.*, SOIL AND WATER ASSESSMENT TOOL (SWAT): THEORETICAL DOCUMENTATION 4 (Jan. 2005), http://swatmodel.tamu.edu/media/1292/SWAT2005theory.pdf (last visited X). For a table of model inputs used in SWAT, *see* C. Santhi, *et al.*, *A modeling approach to evaluate the impacts of water quality management plans implemented in a watershed in Texas*, 21 ENVTL. MODELLING & SOFTWARE 1141, 1147 (2006).

[265] Gassman, *et al.*, *supra* note 263, at 1233, 1240.

[266] "EPIC was originally developed to simulate the impact of erosion on crop productivity and has now evolved into a comprehensive agricultural management, field scale, nonpoint source loading model." Neitsch, *et al.*, *supra* note 264, at fn 4.

[267] Phillip W. Gassman, *et al.*, *The Agricultural Policy Environmental EXtender (APEX) Model: An Emerging Tool for Landscape and Watershed Environmental Analyses* 3 (Ctr. Ag. & Rural Dev., April 2009), *available at* http://www.card.iastate.edu/publications/DBS/PDFFiles/09tr49.pdf.

[268] *Id.* at 97.

[269] Marc O. Ribaudo, *et al.*, *Environmental indices and the politics of the Conservation Reserve Program*, 1 ECOL. INDICATORS 11 (2001).

[270] THE SMITHSONIAN INSTITUTION MONITORING AND ASSESSMENT OF BIODIVERSITY PROGRAM, BIODIVERSITY: CONNECTING WITH THE TAPESTRY OF LIFE at 4, *available at* http://www.nrcs.usda.gov/technical/ECS/wildlife/primermedres.pdf. "Scientists often speak of three levels of diversity - species, genetic and ecosystem diversity. In effect, these levels cannot be separated. Each is important, interacting with and influencing the others. A change at one level can cause changes at the other levels." *Id.*

[271] NRCS, NATIONAL BIOLOGY HANDBOOK, Parts 600-640, *available at* http://www.nrcs.usda.gov/technical/biology.html.

NBH recognizes the value of perennial grasses in corridors and buffer strips, it does not elaborate on the role of larger-scale energy biomass cropping in biodiversity enhancement.

NRCS also funds the Agricultural Wildlife Conservation Center (AWCC) to research habitat needs on agricultural lands and develop conservation technologies, which in turn can be considered in producers' conservation management planning and practices.[272] The AWCC maintains many publications to assist producers in conserving and building fish and wildlife habitat.[273]

IV. Agro-Environmental Subsidy Programs As a Score-Card for Biomass Sustainability

Two options for increased environmental sustainability in agriculture historically have dominated U.S. agricultural policy: (1) retirement of lands for conservation purposes; or, incentives to change existing agricultural practices.[274] Over the past three decades, land set-aside has received the majority of federal funding.[275] The 2002 Farm Bill, however, signaled a new focus on achieving sustainability while keeping land in agricultural production.[276] While perhaps more cost effective, researchers only are beginning to explore the environmental tradeoffs between idling land for conservation and conservation through management practices.[277]

In addition to BCAP, which subsidizes energy biomass production if produced pursuant to a conservation plan, energy biomass producers may receive additional federal assistance by participating in "working lands" environmental enhancement programs such as the Conservation Stewardship Program (CSP), the Environmental Quality Incentives Program (EQIP), and the Wildlife Habitat Improvement Program (WHIP). The Conservation Reserve Program (CRP) also contains a mechanism for evaluating the potential environmental benefits of idling agricultural land while accommodating a certain level of biomass harvests. The new suite of working lands conservation programs, as well as the more well-developed CRP protocols, conceivably provide policymakers an option for "grading" biomass sustainability. These programs contain assessment mechanisms and indicators that could initially provide a stand-alone sustainability framework while the biomass industry develops economically and scientific research more fully grasps the environmental benefits (and perhaps harms) of energy biomass cropping. Or, sustainability metrics within existing agro-environmental programs could inform individual criteria and metrics development for NRCS or in emerging biomass-specific standards.

A. The Conservation Stewardship Program (CSP)

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[272] NRCS, *About the Agricultural Wildlife and Conservation Center*, *available at* ftp://ftp-fc.sc.egov.usda.gov/WHMI/WEB/aboutawccprojects.pdf.
[273] NRCS, Resources, Publications, Tools, Input from AWCC, *available at* ftp://ftp-fc.sc.egov.usda.gov/WHMI/WEB/resources.pdf.
[274] Hongli Feng, *et al.*, *Environmental Conservation in agriculture: Land retirement vs. changing practices on working land*, 52 J. ENVTL. ECON. & MGMT. 600 (Jul. 2006).
[275] *Id.*
[276] *Id.*
[277] *Id.* at 600-601.

The Conservation Stewardship Program began as the Conservation Security Program, enacted as part of the 2002 Farm Bill.[278] The 2008 Farm Bill changed the name of the program to the Conservation Stewardship Program (CSP) and made several substantive changes.[279] The CSP provides funding through 2012 for producers to both improve existing and incorporate new conservation practices into their operations.[280] NRCS allocates each year's acreage by land use.[281] The majority of the operation's land must be in a watershed.[282] Monies are now available nationwide[283] through continuous sign-up periods in which NRCS ranks proposals through a point-scoring process.[284] Top-ranked projects receive CSP funding.[285] Producers cannot receive CSP payments for services already reimbursed under the Conservation, Grassland, or Wetlands reserve program, or for newly converted land except under certain circumstances.[286] NRCS estimates total program costs over 10 years at $12 billion.[287]

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[278] *The Farm Security and Rural Investment Act of 2002*, Pub. L. No. 107-171, 116 Stat. 134 (May 13, 2002) [hereinafter 2002 Farm Bill]. The program's overall goal was to encourage conservation practices beneficial to air, water, soil, wildlife, and energy conservation, including nutrient management, integrated pest management, water conservation and water quality management, grazing/pasture/rangeland management, soil conservation/quality/residue management, fish and wildlife habitat conservation/restoration/management, air quality management, energy conservation measures, biological resource conservation and regeneration, contour farming, strip cropping, cover cropping, controlled rotational grazing, resource-conserving crop rotation, and native grassland and prairie protection/restoration. *Id.* § 1238A(d)(4). Direct payments and technical assistance for these practices, however, were only available in certain watersheds designated by NRCS.

Producers enrolled in the original CSP received payments while maintaining land in agricultural production, based on a three-tiered payment system subject to maximum annual payment caps and contract terms varying between 5 and 10 years. In return for payment, producers agreed to conserve at least one resource concern (e.g., water, air, soil) on at least a portion of the enrolled acreage, or for increased payment, one or more additional measures on all areas of production. Enhanced payments were available for, among other practices, participation in a regional conservation plan and assessment of conservation practices. Producers were required to submit a "conservation security plan" approved by NRCS that identified enrolled acreage, conservation practices, and an implementation schedule. Producers did not compete for funding; instead, if the producer met the program standards, the land would be eligible for payment. *Id.*

[279] 2008 Farm Bill, *supra* note 42, codified at 16 U.S.C. § 3838d-3838g.

[280] *Id.* § 3838e(a).

[281] For 2009, 40% of payments go to cropland, 7% to pastureland, 45% to rangeland, and 8% to non-industrial private forestland. NRCS, *Conservation Stewardship Program, Payment for Performance*, http://nrcs.usda.ogv/new_csp/perform.html (last visited X).

[282] 16 U.S.C. § 3838g(a)(2); *See also* NRCS, CSP MANUAL, Title 440, Subpart E, § 518.42(B) [hereinafter CSP MANUAL].

[283] 16 U.S.C. § 3838g(a). Congress limits priority resource concern designation in each state to between 3 and 5 resource concerns, depending on the number of agricultural acres, the conservation needs, and the program's ability to meet those needs in each state, as well as other equitable factors. *Id.* § 3838g(a)(2).

Under the prior Conservation Security Program, monies were only available in select watersheds. For a map of eligible fiscal year 2008 watersheds, *see* http://www.nrcs.usda.gov/programs/CSP/CSP_2008/2008_images/m9985_US.jpg (last visited X).

[284] 16 U.S.C. § 3838f(b); CSP MANUAL, *supra* note 282, at § 518.40 (eligibility requirements).

[285] The statute requires payments per acre to average a maximum of $18, which includes both the annual payment and NRCS technical assistance. 16 U.S.C. § 3838g(d). Producers are required, to obtain payment, to have a record in the FSA farm management system that contains information, among other things, baseline eligibility in relation to highly erodible land and wetland conservation requirements. Each producer may receive up to $40,000 in CSP payment. *Id.* § 3838g(g).

[286] 16 U.S.C. § 3838e(c). Also excluded are costs for animal waste treatment systems, or activities for which the producer incurs no costs. *Id.* § 3838g(e)(4).

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Unlike the previous Conservation Security Program that rewarded projects using a tiered system, project proposals under the new Conservation Stewardship Program compete on additionality.[288] That is, in order to qualify for payment, producers must meet a "stewardship threshold" for one "resource concern" at the time of contract, maintain those practices to support that threshold, and meet or exceed an additional priority stewardship threshold for one additional resource concern by the end of the five-year contract period ("enhancements").[289] A "stewardship threshold" is the level of management necessary to "conserve and improve the quality and condition of a natural resource."[290] State Conservationists, in consultation with the State Technical Committee and local working groups, identify priority resource concerns for a State, or a specific geographic area within the state, that relate to water quality and quantity, soil quality, air quality, and wildlife habitat.[291] If eligible, producers can receive payment for costs incurred, foregone income, and the environmental benefits they provide.[292] Producers also can receive supplemental payments for resource-conserving crop rotation,[293] as well as participation in on-farm research, demonstration, and pilot testing.[294] The producer has an option to renew a CSP contract, but must show that an additional priority resource concern is being met, and agree to "adopt additional conservation activities to address at least one additional priority resource concern during the term of the renewed conservation stewardship contract.[295]

The state conservationist or his or her designate ranks project applications using the Conservation Measurement Tool (CMT).[296] The CMT determines a project's "conservation performance" using a point system that measures relative physical effects instead of "true" environmental benefits.[297] During the first sign-up period in 2009, NRCS and a panel of experts developed a set of questions to evaluate existing practices and to score practices that would lead to additional enhancements.[298] Project applications are ranked on five factors: (1) the level of "conservation treatment" on all applicable priority resource concerns at the time of application; (2) the degree to which the proposal increases performance related to those priority resource

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[287] The Sustainable Agriculture Coalition, *The Conservation Stewardship Program*, http://sustainableagriculture.net/publications/grassrootsguide/conservation-environment/conservation-stewardship-program/ (last visited X).

[288] 16 U.S.C. § 3838e(a).

[289] *Id.* § 3838f(a). Commodity Credit Corporation, *Conservation Stewardship Program; Final Rule*, 75 Fed. Reg. 31610, 31657 (Jun. 3, 2010) (codified at 7 C.F.R §1470.20(b)) [hereinafter CSP *Final Rule*].

[290] *Id.* at 31656 (codified at § 1460.3 (definitions)).

[291] *Id.* at 31653 (to be codified at 7 C.F.R. § 1470.1(e)(2)(ii)). The statute defines "resource concerns" as a "specific natural resource impairment or problem. . . that, represents a significant concern in a State or region. . . and is likely to be addressed successfully through the implementation of conservation activities. . ." 16 U.S.C. § 3838d(6).

[292] 16 U.S.C. §3838g(e)(2). NRCS's formula for the annual land use portion of the award takes the number of acres, multiplied by existing and new activity performance points, multiplied by the land use payment rate. NRCS sets payment rates yearly for each performance point. CSP MANUAL, *supra* note 282, at § 518.80 (establishing CSP payments).

[293] *Id.* § 3838g(f). The crop must reduce erosion, improve soil fertility and health, interrupt pest cycles, and reduces depletion of soil moisture or otherwise reduce the need for irrigation. *Id.* at § 3838g(f)(4). "Resource conserving crops" include perennial grasses, "a legume grown as use for forage, seed for planting, or green manure," a legume-grass mixture, and "a small grain grown in combination with a grass or legume whether inter-seeded or planted in rotation." CSP *Final Rule*, *supra* note 289, at § 1470.3 (definitions).

[294] 16 U.S.C. § 3838f(i).

[295] CSP *Final Rule*, *supra* note 289, at § 1470.26(b)(3)-(4).

[296] *Id.* at 1470.20(c)(2).

[297] 16 U.S.C. § 3838f(b)(1)(B); 3838g(a)(3).CSP *Final Rule*, *supra* note 289, at 31617.

[298] *Id.* at 31614.

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concerns; (3) the number of priority resource concerns that the applicant proposes to be treated in order to meet or exceed the stewardship threshold; (4) additional resource concerns that will be treated to meet or exceed the stewardship threshold; and, where a tie-breaker is necessary, (5) the extent to which the project represents the least cost to the program.[299] The NRCS website contains CMT questionnaires (e.g., for crops or forestland) that solicit information on rotations, variety of crops, flooding for wildlife, cover cropping, harvesting techniques that are favorable to wildlife, other habitat-friendly practices, water conservation and residue management strategies, nutrient and pest management, and irrigation management.[300] The NRCS website also contains a list of "enhancement activity job sheets" that span a variety of conservation practices.[301] As a condition of CSP funding, the producer must implement a conservation stewardship plan that follows the general NPPH process outlined *supra*.[302] The conservation stewardship plan contains a description and implementation schedule for "benchmark" enhancement activities, and new enhancement activities and conservation practices.[303] Where new technology exists that "ha[s] a high potential for optimizing environmental benefits" (which is very likely in an energy biomass production scenario), NRCS will approve a CSP payment for the practice until a practice standard can be developed.[304] NRCS has reserved a section in its CSP handbook for "environmental performance analysis," presumably as part of recent efforts to better evaluate the performance of conservation programs.[305]

B. The Environmental Quality Incentives Program (EQIP)

When a producer does not reach the threshold requirements for the CSP program, EQIP monies may be available. Congress created EQIP in 1996 to incentivize agricultural and forest producers to provide increased environmental benefits through direct financial payment and NRCS technical assistance.[306] NRCS administers the program through State Conservationists.[307] EQIP is based on national resource priorities that include reduction in non-point source water pollution, air pollution, and soil erosion, as well as promotion of habitat conservation for "at-risk species."[308] These goals are incorporated into conservation management planning and implementation, and enforced through contract with a maximum duration of 10 years.[309] Forty

[299] *Id.* at 31657-31658 (codified at § 1470.20(c)(2)-(3)). For a detailed explanation and evaluation of the CMT, *see* CSP Cost-Effectiveness Study, *infra* note 368.
[300] NRCS, Conservation Stewardship Program, FY2010 Ranking Period Two, *available at* http://www.nrcs.usda.gov/programs/new_csp/csp.html (listing all of the questionnaires); NRCS, Conservation Measurement Tool, Cropland Existing Activity Conservation Performance (2010 Ranking Period 2), *available at* http://www.nrcs.usda.gov/programs/new_csp/2010/ranking_period_two/cmt_questions_pdfs/CMT_Tool_Cropland_4_19_10.pdf (cropping questionnaire).
[301] NRCS, Conservation Stewardship Program, Introduction, 2010 Ranking Period Two Enhancement Activity Job Sheets, *available at* http://www.nrcs.usda.gov/programs/new_csp/2010_jobsheets-rp-two.html#energy.
[302] CSP *Final Rule*, *supra* note 289, at §§ 1470.21(b)(4)(i), 1470.22.
[303] NRCS MANUAL, Title 440, Part 518 (Conservation Security Program). §518.70(B).
[304] *Id.* §518.71(B). *See also supra* note 142 (explaining the procedure in the NCPH for adding new practices).
[305] *Id.* Part 518, Subpart O; *see infra* Part V (evaluation of whether NRCS conservation programs have been effective).
[306] The Federal Agricultural Improvement and Reform Act of 1996, Pub. L. No. 104-127, § 334, 116 Stat. 269 (codified at 16 U.S.C. §3839aa); Commodity Credit Corporation, *Environmental Quality Incentives Program: Interim Final Rule*, 74 Fed. Reg. 2293-2317 (Jan. 15, 2009) (codified at 7 C.F.R. Part 1466).
[307] *Id.* § 1466.5.
[308] *Id.* § 1466.4(a).
[309] *Id.* §§ 1466.8(a); 1466.9.

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percent of EQIP funding is available for non-livestock related practices.[310] Payments may not exceed $300,000 per entity.[311]

NRCS scores both EQIP and Wildlife Habitat Incentives Program (WHIP) projects using "Application and Evaluation and Ranking Tool" (AERT) criteria specific to each program.[312] Projects receive funding based on State Conservationist rankings of cost-effectiveness, the magnitude and longevity of environmental benefits, compliance with all laws, timeliness in implementing the practices, and improvement of existing conservation practices.[313]

C. The Wildlife Habitat Incentives Program (WHIP)

Congress created the Wildlife Habitat Incentives Program (WHIP) to assist agricultural producers, through a cost-share program valued at up to $50,000 per year per producer,[314] in creating habitat for upland and wetland wildlife, endangered and threatened species, fish, and other priority habitat.[315] The State Conservationist, in consultation with the State Technical Committee, is charged with implementing the program.[316] NRCS can enter into agreements with local agencies and private conservation groups to implement the program, and can set species and geographical priorities each year.[317] "General" WHIP funding (up to 75% of the cost of installing the conservation practice(s)) is available for projects lasting between 5 and 10 years that develop habitat.[318] Funding for longer term projects (up to 90% cost-share for up to 15 years) is available for projects that protect and restore plant and habitat.[319] The 2010 payment schedule for WHIP practices includes cover cropping and plant species for pollinators.[320]

NRCS selects projects by ranking them according to whether they address an identified local, state or national habitat problem, their relationship to a established conservation or wildlife areas, the expected length of benefits proposed by the project, whether the project can be self-sustaining, the availability of matching funding, the estimated cost of the project, and any other appropriate factors determined by NRCS.[321] Both national issues and state-specific issues are

[310] *Id.* § 1466.8(d).
[311] *Id.* § 1466.24(a).
[312] NRCS, GENERAL MANUAL, Title 440 (Programs), Part 512 (Conservation Program Contracting), §515.20(D).
[313] *Id.* §§ 1466.20; 1466.21(b)(2). *See also e.g.*, Illinois NRCS, *EQIP 2010 Web-Based Ranking Criteria Tools*, General EQIP (Jan. 2010), *available at* http://www.il.nrcs.usda.gov/programs/eqip/index.html.
[314] The producer is eligible for up to 75% of the project cost, except that the payment is reduced if the producer receives other funding. 7 C.F.R. § 636.6(a). For projects that achieve benefits longer than 15 years, the statute provides for increased funding above this cap. 16 U.S.C. § 3839bb-1(b)(2).
[315] Federal Agriculture Improvement and Reform Act of 1996, Pub. L. No. 104-127, § 387, 116 Stat. 269 (codified at 16 U.S.C. § 3839bb-1); Commodity Credit Corporation, *Wildlife Habitat Incentives Program: Interim Final Rule*, 62 Fed. Reg. 49357-49368 (Sept. 19, 1997) (codified at 7 C.F.R. Part 636).
[316] 7 C.F.R. § 636.2(b).
[317] *Id.* §§ 636.2(c)-(d); 636.5(a).
[318] *Id.* §§ 636.6; 636.8(b).
[319] Up to 25% of total WHIP funding is available for these types of projects. 16 U.S.C. § 3839bb-1(b)(2)(B); 7 C.F.R. § 636.8(d). *See also NRCS, Farm Bill 2008, Fact Sheet: Wildlife Habitat Incentive Program* (Mar. 2009), *available at* http://www.nrcs.usda.gov/farmbill/pdfs/whip_factsheet.pdf.
[320] *See e.g.*, WHIP Payment Schedule—General (2010) (Illinois), and WHIP Payment Schedule –Essential Habitats, *available at* http://www.il.nrcs.usda.gov/intranet/nrcsemp/bulletins/FY2010/il300-10-11.html. schdl_EsntlHU_0509.pdf.
[321] 7 C.F.R. § 636.5(c)(1)-(7).

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identified in the ranking process.[322] If chosen, participants must develop a wildlife habitat development plan (WHDP), part of which is accomplished through the general NRCS planning process outlined above.[323]

D. The Conservation Reserve Program (CRP)

The Conservation Reserve Program (CRP), established by the 1985 Farm Bill, is the largest conservation program in the U.S. by acreage and expenditures.[324] CRP aims to "conserve and improve soil, water and wildlife resources," and Congress has expressed a desire that the three be equitably balanced.[325] Land eligible for the program include HELs, certain marginal pasture land converted to wetlands or wildlife habitat, marginal pasture land devoted to water quality uses, and other type of lands that are otherwise ineligible that would provide types of environmental benefits.[326] Congress has capped the total number of eligible acres at 32 million between 2010 and 2012,[327] and no more than 33% of land within any state can be CRP land.[328] Contracts pay an annual rent and half the cost of establishing permanent land cover, and last between 10 and 15 years.[329] NRCS can designate priority areas for funding if significant adverse air, water, wildlife, or other resource issues related to agriculture exist.[330] Producers can either submit applications for the continuous sign-up program (for "environmentally desirable land") or general signup.[331]

The CRP program could serve as an informative model for biomass sustainability standard development, as it contains an assessment mechanism, indicators, and management planning component.[332] As with the proposed BCAP rules regarding conservation planning, producers enrolled in CRP must prepare a conservation plan approved by CCC according to CCC guidelines.[333] The regulations do not specifically reference those guidelines as separate from those maintained by NRCS, discussed *infra*. Project applications submitted during a general sign-up period (the last one was held in 2006), are ranked by FSA according to an Environmental Benefits Index (EBI).[334] Not unlike the CMT for the Conservation Stewardship Program, FSA assigns each chosen environmental factor a point score.[335] In 2006, the factors included: (1) wildlife habitat enhancement from cover crops; (2) water quality benefits of reduced erosion, runoff, and leaching; (3) on-farm benefits of reduced erosion; (4) benefits

[322] *See e.g.*, *Illinois NRCS WHIP Ranking Criteria, Fiscal Year 2009, available at* ftp://ftp-fc.sc.egov.usda.gov/IL/farmbill/WHIPrank-Gen_0509.pdf.
[323] *Id.* § 636.7.
[324] Food Security Act of 1985, Pub. L. No. 99-198, § 1231, 99 Stat. 1354 (Dec. 23, 1985) (codified at 16 U.S.C. § 3831); *see also* Ribaudo, *supra* note 269, at 12.
[325] *Id.* § 3831(a), (i).
[326] *Id.* § 3831(b)(4)(A)-(E).
[327] *Id.* § 3831(d).
[328] 7 C.F.R. § 1410.8(b).
[329] 16 C.F.R. § 3831(e)(1).
[330] 7 C.F.R. § 1410.8(c).
[331] Farm Service Agency, *The Conservation Reserve Program, available at* http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=crp.
[332] Ribaudo, *supra* note 269, at 12.
[333] 7 C.F.R. § 1410.22.
[334] USDA, *Fact Sheet, Conservation Reserve Program General Sign-up 33, Environmental Benefits Index* (April 2006), *available at* http://www.fsa.usda.gov/Internet/FSA_File/crp33ebi06.pdf.
[335] *Id.*

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"likely to endure beyond the contract period;" (5) air quality benefits from reduced erosion; and, (5) cost.[336] FSA assigns increased value to cover crops that provide the most benefits to wildlife, particularly native mixes and designated wildlife priority zones.[337] It is unclear what methodology is used to assign values to these environmental benefits. To gain certain wildlife habitat points, the producer must prepare a wildlife conservation plan.[338]

IV. Concluding Thoughts: Toward a Credible, Feasible Measure of Biomass Sustainability

Bioenergy policies present both challenges and opportunities moving forward in relation to achieving greater levels of agricultural sustainability. Formidable structural problems lie within and between bioenergy legislation. Coordination must improve between and within federal and state agencies, and other standard setting groups, which are currently developing sustainability policies. Further, new demands for agricultural sustainability, regardless of the cropping system, strain already taxed agency budgets and require the supporting technical expertise and data that just may not be available yet, even in the best of budgetary times. That said, proliferating bioenergy policies present a unique opportunity to reconsider the path forward despite these shortcomings, not just for energy biomass, but for increased sustainability of the agricultural sector as a whole.

First, policymakers must reconcile the definition of "renewable biomass" between RFS2 and BCAP so that first and second generation feedstocks are on even and good footing. That is, policies should reward consistently the environmental benefits from perennial versus other commodity cropping.[339] While corn and soy-based fuels have benefitted from EPA's continued refinement of LCA analyses under RFS2, and similarly under California's LCFS, USDA only eluded to GHG requirements in the proposed BCAP rule. On the flip side, EPA did not clarify in the 2010 Final RFS2 Rule what, if any, sustainability concerns beyond GHG emissions will be addressed in future rulemaking. Indeed, EPA resisted in the Final Rule use of sustainability certification as a method of complying with the land conversion proscription.[340] The BCAP proposed rule, on the other hand, requires producers to maintain an NRCS conservation plan.[341] If no Title I crops are eligible for BCAP subsidies, but those that are (e.g., perennial grasses) are subject to conservation planning despite the likelihood that they can provide environmental

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[336] *Id.* at 1.
[337] *Id.* at 1-2.
[338] *Id.* at 4.
[339] For a detailed accounting of the sustainability concerns related to corn production, including for ethanol, *see* Angelo, *supra* note 6, at 654-655; and, Melissa Powers, *King Corn: Will the Renewable Fuel Standard Eventually End Corn Ethanol's Reign?* 11 Vt. Envtl. L. J. 667 (2010); for the concerns related to soy-based biodiesel, *see e.g.*, Otávio Cavalett & Enrique Ortega, *Integrated Environmental Assessment of biodiesel production from soybean in Brazil*, 18 J. OF CLEANER PROD. 55-70 (Jan. 2010) (concluding that "the fraction of fuel that can actually be considered renewable is very low (around 31%)"); A SEED *et al.*, *A briefing on the impacts of the Roundtable on Responsible Soy* (Apr. 2008), *available at* http://www.lasojamata.net/files/RTbriefing%202008_6.pdf (contending that the Roundtable for Responsible Soy criteria "provide a valuable coat of greenwash, legitimizing the damaging practice on the ground").
[340] *See supra* text at notes 37-39. A petition has been filed asking EPA to reconsider its "aggregate compliance" rule, arguing that the interpretation does not meet EISA's strict statutory language, and that land conversion will occur under such regime. *See* Petition for Reconsideration, *In the Matter of the Final Rule: Regulation of Fuels and Fuel Additives: Changes to Renewable Fuel Standard Program*, EPA Docket No. EPA-HQ-OAR-2005-0161 (May 21, 2010), available at http://www.catf.us/resources/filings/biofuels/20100521-CATF_Petition_for_Reconsideration_of_RFS2.pdf.
[341] *See supra* text at notes 53-56.

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benefits superior to monocropped corn or soy, those same Title I feedstocks that qualify for RFS2 (albeit up to a 15 billion gallon threshold) should be required to meet minimum sustainability considerations as well.[342]

California has done a better job in making sure that its biomass sustainability policies are consistent between programs through such mechanisms as the A.B. Scoping Plan[343] and Bioenergy Action Plans,[344] which provide an "umbrella" that guides development of all GHG–related bioenergy projects, and interagency groups such as the Interagency Forestry and Bioenergy Working Groups whose meetings and proceedings are open to the public and easily accessible online.[345] Although President Obama created a similar Biofuels Interagency Working Group in 2009, whether or not it has, or will, consider recommendations for consistent sustainability definitions in light of the President's new "integrated approach" announced in 2010 is unknown, as their inner workings (e.g., meetings, documents) are not readily publically available. The Office of Management and Budget (OMB) conducts similar analyses when clearing a Final Rule, but this too is not open to public input. Although EPA successfully posted the thousands of comments to its proposed RFS2 rule on the regulations.gov website so that comments could be remotely analyzed, FSA only posted a small portion of the 20,000+ comments to the BCAP proposed rule. The public, therefore, is left to rely on an agency's summary of comments in a Final Rule, which can leave out important nuances that would be helpful to further research to improve future policies.

In the end, if policies begin to attach sustainability requirements to corn and soy production because they, too, are feedstocks for "bio" fuels, bioenergy policies will have served to improve sustainability within a large portion of the entire agricultural sector–something that other policies have struggled to achieve over the past 25 years. But, what should sustainability requirements look like? One option would be to require NRCS conservation planning for all agricultural production that receives federal subsidies. As demonstrated in Part III, NRCS has a framework in place for identifying the environmental problems within the landscape, practice standards to address those concerns, and a conservation planning process for producers to implement and assess those practices. However, this would increase NRCS's workload substantially even from a sheer numbers perspective, at a time when Congress is cutting conservation program funding.[346]

Another hurdle to adoption of the NRCS conservation framework is that NRCS practice standards and models are not yet specific to second generation crops such as miscanthus or switch grass, except to the extent that cover crop practices can be analogized to the practices and outcomes associated with perennial biomass cropping. In addition, carbon sequestration and

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[342] *See, e.g.*, Annise McGuire, *Shifting the Paradigm: Broadening our Understanding of Agriculture and Its Impact on Climate Change*, 33 Environs Envtl. L. & Pol'y 275, 306-307 (Spring 2010) (agreeing that at a minimum, farm subsidies be redesigned to include sustainability requirements for mitigating climate change).

[343] CALIFORNIA AIR RESOURCES BOARD, CLIMATE CHANGE SCOPING PLAN (Dec. 2008), http://www.arb.ca.gov/cc/scopingplan/document/adopted_scoping_plan.pdf.

[344] *See* Executive Order S-06-06 (Apr. 25, 2006) (directing state agencies to cooperate in developing a sustainable biomass plan for California); California Energy Commission, Bioenergy Action Plan-Documents Page, http://www.energy.ca.gov/bioenergy_action_plan/documents/index.html (last visited X).

[345] California Board of Forestry and Fire Protection, Charter of the Interagency Forestry Working Group on Climate Change (Apr. 7, 2009), http://www.bof.fire.ca.gov/board_committees/interagency_forestry_working_group/mission_and_goals/charter/ifwg_charter_final4-7-09.pdf; Executive Order S-06-06, *supra* note 343.

[346] *See generally*, Environmental Working Group, Craig Cox, *Congress Poised to Cut Conservation Funds That Aided Farm Bill's Passage* (Sept. 2008), http://www.ewg.org/reports/conservationcuts

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GHG emissions are not considered specifically, except to the extent soil organic matter can serve as a proxy. NRCS, therefore, would have to take steps to incorporate, where necessary, new or adjusted practice standards that contribute to carbon sequestration and curtail GHG emissions based on the most recent science.[347] The parameters and data that make up the Soil Conditioning Index and DAYCENT/CENTURY models also should be reconciled so that producers can use one tool in determining overall sequestration or emissions. USDA has indicated that work is under way in this regard. One place that NRCS may be able to look to in the future, once it is built, is the "best practices database" for biomass cropping created by the 2008 Farm Bill's Agricultural Bioenergy Feedstock and Energy Efficiency Research and Extension Initiative.[348] The program provides grants to research that can close many of the knowledge gaps in biomass production, including crop species selection, nutrient management, management practices, environmental impacts, and economics.[349] In all respects, NRCS should avail itself of its process for developing interim practice standards so that sustainable practices can be adopted as timely as possible.[350]

"Assessing the impact of [sustainable farming practices] on biodiversity and ecosystem services is fundamental" to "the reconciliation of demands for biodiversity conservation and increased agricultural production" inherent in sustainable development policy.[351] Although accountability mechanisms for conservation programs have been in place since at least 1977,[352] some question whether the NRCS conservation framework alone truly can achieve significant sustainability gains despite the amount of data that USDA gathers on environmental performance.[353] When additional conservation programs such as the CSP and EQIP were added in the 2002 Farm Bill, NRCS initiated the Conservation Effects Assessment Project (CEAP), bringing together multiple federal agencies to scientifically quantify the beneficial effects of USDA's conservation programs and the potential to improve on conservation practices.[354]

The three core elements of the CEAP include regional and national assessments of how conservation practices can meet environmental goals within different systems (i.e., cropland, wildlife, wetlands, and grazing lands)[355], watershed-focused assessments,[356] and identification of

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[347] Esther Turnhout, *et al.*, *Ecological indicators: between the two fires of science and policy*, 7 ECOL. INDICATORS 215-228 (Apr. 2007).
[348] 2008 Farm Bill, *supra* note X, at § 7207 (codified at 7 U.S.C. § 1672C).
[349] *Id.* at 1672C(c)(1)(A).
[350] *See infra* Part III.A.2 at n. 142 (detailing the interim standard process).
[351] S.J. Butler, *et al.*, *Farmland Biodiversity and the Footprint of Agriculture*, 19 SCIENCE 381 (Jan. 2007).
[352] *See infra* note 362 (Soil and Water Resource Conservation Act of 1977).
[353] *See e.g.*, GENERAL ACCOUNTING OFFICE, AGRICULTURAL CONSERVATION: USDA NEEDS TO BETTER ENSURE PROTECTION OF HIGHLY ERODIBLE CROPLAND AND WETLANDS (Apr. 2003), *available at* http://www.gao.gov/new.items/d03418.pdf (noting systemic problems with NRCS conservation program enforcement); USDA Economic Research Service, *Agricultural Resources and Environmental Indicators*, Appendix (2006), *available at* http://www.ers.usda.gov/publications/arei/eib16/.
[354] Soil and Water Conservation Society, Blue Ribbon Panel, *Final Report: Conservation Effects Assessment Project* at 9 (2006), *available at* http://www.swcs.org/documents/filelibrary/advocacy_publications/CEAP_Final_Report.pdf [hereinafter SWCS Blue Ribbon Panel].
[355] *Id.*
[356] Thirty-eight assessments were carried out in the first five years of CEAP. Lisa F. Duriancik, *et al.*, *The first five years of the Conservation Effects Assessment Project*, 63 J. SOIL & WATER CONSERV. 186A (Nov./Dec. 2008); USDA National Agriculture Library, CEAP Bibliographies, *available at* http://wqic.nal.usda.gov/nal_display/index.php?info_center=7&tax_level=3&tax_subject=595&topic_id=2422&level3_id=6990&level4_id=0.

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current knowledge through literature reviews and workshops to identify the state of current science and gaps in scientific understanding.[357] In 2005, USDA created a blue ribbon panel lead by the Soil and Water Conservation Society to assess USDA's plan and make recommendations on how to ensure CEAP's credibility and utility.[358] Four framework questions emerged from the discussions that should apply to an evaluation of any sustainability scheme: (1) what should be measured, and how to account for effects at watershed or landscape levels; (2) what are the scientific methods that can be used to evaluate these effects; (3) how to target practices within the landscape or watershed to improve outcomes; and, (4) realistic expectations of the time it will take conservation practices to achieve environmental improvement.[359]

The Panel issued several recommendations. First, it logically suggested that before measuring effects of conservation practices, USDA must determine what should be accomplished in the first place.[360] As part of this determination, NRCS could rely, in part, on resource assessments done as part of conservation planning to determine what areas require priority attention.[361] Further, the Panel urged USDA to consider the context in which the effect occurs. That is, an effect in a highly sensitive watershed or wildlife habitat is greater than one accomplished in isolation or in less sensitive areas.[362] The Panel emphasized actual monitoring over modeling that can be plagued by "uncertainty and error" due to missing data, inability to accurately correlate a practice with an effect, and the difficulty in simulating complex ecosystem function.[363] The Panel urged Congress to reauthorize the Soil and Water Resource Conservation Act of 1977 (RCA) to provide further support and an umbrella framework for all assessments of federal conservation activities,[364] which Congress did in the 2008 Farm Bill.[365] Pursuant to the RCA and 2008 Farm Bill amendments, NRCS must report its assessment of conservation practices and their effects to Congress in 2011,[366] shortly after EPA will report on the RFS2's environmental effects.[367] Lastly, the Panel recommended that the Office of Management and Budget, which plays a key role in reviewing final regulations, focus on evaluating overall, cumulative outcomes of conservation programs using their Program Assessment and Rating Tool.[368] Although not addressed in the Panel's report, policymakers should consider what role

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[357] *Id.* at 185A.
[358] *Id.* at 185A-186A.
[359] *Id.* at 186A.
[360] SWCS Blue Ribbon Panel, *supra* note 353, at 10.
[361] *See supra* section III.A.1 (Identifying the Resource Concern(s)). *But see* SWCS Blue Ribbon Panel *supra* note 353, at 6 (urging NRCS to use the NRI more effectively by gather more useful statistical information that in turn can be scientifically analyzed).
[362] *Id.* at 10.
[363] *Id.* at 11.
[364] *Id.* at 13.
[365] Soil and Water Resource Conservation Act of 1977, Pub. L. No. 95-192 (codified at 16 U.S.C. § 2001-2009) [hereinafter RCA]; 2008 Farm Bill, *supra* note 42, § 2804. The RCA requires the Secretary of Agriculture to periodically assess that state of soil and water resources, design, implement and update a plan to conserve those resources, the report results to Congress. Specifically, the Act charges NRCS with gathering categories of data, including (1) soil, water and related resources, including fish and wildlife habitat; (2) the capabilities and limitations on those resources to meet current and future needs; (3) how agricultural practices have played a role in changing resource abilities; (4) conservation-related laws and policies; (5) the costs and benefits of conservation practices; (6) irrigation techniques and their impacts. RCA, at § 5.
[366] For general information on NRCS efforts in this regard, *see* NRCS, *Soil and Water Resources Conservation Act*, http://www.nrcs.usda.gov/technical/rca/ (last visited X).
[367] *See infra* text at notes 40-41.
[368] SWCS Blue Ribbon Panel, *supra* note 353, at 15.

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assessments done pursuant to National Environmental Policy Act (NEPA) can play in evaluating the likely effects of conservation practices.[369] Executive Orders also require some level of effectiveness analysis.[370] In light of all of these assessment efforts, Congress and the Executive Branch must consider unifying all of these different assessments into one omnibus scheme for setting environmental goals and measuring practices' effects so as to avoid what appears to be inefficient redundancy.

While these important assessments are occurring,[371] which hopefully will shed new light on the right direction for federal agricultural sustainability policy overall and specifically within NRCS, the CSBP concurrently will be providing the type of ground level assessment and monitoring recommended by the CEAP blue ribbon panel.[372] The CSBP is field-testing its standard during the 2010 and 2011 growing seasons at a scale large enough to adequately gauge the effect of sustainability practices. National NRCS representatives participate in the CSBP process as advisors, and producers will be working with their local NRCS offices to identify and solidify synergies between the NRCS framework and the CSBP provisional standard. The Council will incorporate results of each field-test into the standard, making modifications as necessary and as knowledge evolves. CSBP will also concurrently study the "value proposition" of a sustainability standard for producers. In order for any biomass sustainability standard to be widely adapted, the producer must see a value proposition of certification.[373] The CSBP Value Proposition Task Force will consider whether a "coarser" version of the standard could be developed for compliance with public policies–whatever those policies may turn out to be–with implementation of the full standard if and when a consumer or ecosystems services market would reward sustainable practices beyond regulatory requirements.

Policymakers also should consider how the measurement tools and other sustainability ranking mechanisms in various federal conservation subsidy programs can be integrated into federal sustainability policy for biomass. One example would be in implementation of BCAP, and how priorities are set for both matching payment and project area funding. Arguably, priority for limited funding should be given to those projects that can prove, like with CSP, CRP, WHIP or EQIP programs, that a certain level of environmental benefit will be achieved. At a broader level, Congress should create, from the various conservation programs, one sustainability scoring mechanism with consistent goals and accompanying qualifying practices,

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[369] Pub. L. No. 91-190, 80 Stat. 852 (codified at 42 U.S.C. §§4321-4370f). For example, the Programmatic Environmental Impact Statement prepared for the BCAP program concluded that site-specific evaluations might be necessary to gauge the impact of biomass crop subsidies on the environment. USDA Farm Service Agency, *Draft BCAP Programmatic Environmental Impact Statement*, 74 Fed. Reg. 39915 (Aug. 10, 2009), *available at* http://www.fsa.usda.gov/Internet/FSA_File/bcapseisbody.pdf [hereinafter PEIS]. For a detailed explanation of the PEIS, *see* Endres, *et al.*, *supra* note X, at 10073-10075.

[370] *See, e.g.*, NRCS, *Final Cost-Effectiveness Analysis for the Conservation Stewardship Program* (May 14, 2010), *available at* http://www.nrcs.usda.gov/programs/farmbill/2008/bca-cria/CSP_BCA-FINAL_5-14-10.pdf (detailing the benefits stemming from the CSP interim rule, as required by Executive Order 12866) [hereinafter CSP Cost-Effectiveness Study].

[371] For example, a cornerstone CEAP assessment of one of the most impacted ecosystems from agricultural practices issued in June 2010. *See* NRCS, ASSESSMENT OF THE EFFECTS OF CONSERVATION PRACTICES ON CULTIVATED CROPLAND IN THE UPPER MISSISSIPPI RIVER BASIN (draft) (June 2010), *available at* http://www.nrcs.usda.gov/technical/NRI/ceap/.

[372] SWCS Blue Ribbon Panel, *supra* note 353, at 11. *See generally* Jon Johnson & Hal Hamilton, OPERATIONALIZING SUSTAINABILITY IN VALUE CHAINS (Dec. 6, 2009) (noting that important decisions cannot be made, including by setting standards, without sufficient and accurate information).

[373] Jinke van Dam *et al.*, *Overview of Recent Developments in Sustainable Biomass Certification*, 32 BIOMASS & BIOENERGY 749, 769 (2008) (discussing the cost levels of certification).

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and that incorporates concepts such as additionality. This would eliminate redundancy for producers and streamline efforts at the NRCS in developing evaluation tools and practice standards. Lastly, as demand for agricultural acreage inevitably grows, incorporating sustainability considerations across-the-board (including into all subsidy or incentives programs) could be an "equalizer" in heated "food versus fuel" debates. Although not the focus of this article, "sustainability" of human eating habits cannot be decoupled from agronomic sustainability considerations and instead must be the next frontier of discussion in relation to subsidization of production for animal feed and not food for direct consumption. How marginal lands are used must also enter the sustainability discussion at the federal level.[374] Only then can energy biomass cropping on productive lands—and marginal lands–be accommodated and the environmental benefits stemming from perennial cropping be fully recognized.

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[374] Marginal and abandoned cropland and pasture, which numbers over 72 million acres in the US, may present the greatest opportunity for energy biomass cropping because it avoids areas traditionally used for food production. Dale, *supra* note 27, at 4. Sustainable land use practices, however, would still have to be deployed to avoid natural resource degradation and to sequester carbon, and sensitive ecological areas of significance must be off-limits altogether. *See id.*; David Tillman, *et al.*, *Carbon-negative biofuels from low-input high diversity grassland biomass*, 314 Science 1598-1600 (2006). And, at the most, scientists estimate the total production potential of these lands at merely 5% of the net world energy supply. *Id.* at 1600.