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CENTURY

New Markets for American Agriculture

21st Century
Agriculture
Policy Project

A REPORT OF THE 21ST CENTURY AGRICULTURE POLICY PROJECT

Senator Bob Dole ▪ Senator Tom Daschle

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Disclaimer

The conclusions and recommendations presented in this report are solely those of Senators Tom Daschle and Bob Dole. They do not necessarily reflect the views of the Bipartisan Policy Center Board of Directors or its Advisory Board.

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EXECUTIVE SUMMARY

America's farmers and ranchers *face unprecedented challenges and opportunities in the decades ahead. Globalization, technological change, trade issues, federal budget constraints, global warming, high energy costs, land-development pressures, and increasing environmental and food safety concerns are all likely to have a profound impact on rural communities and on future prospects for sustaining a prosperous and vibrant farm economy. At the same time, new markets are opening to farmers that already are paying enormous dividends. Investments in biofuels projects and wind farms, as well as the generation of carbon credits, are providing farmers and ranchers with new sources of income that are* **transforming the rural American economy.**

The 21st Century Agriculture Policy Project was motivated by a recognition that this rapidly changing landscape calls for a more expansive and creative approach to national farm policy. Sponsored by the Bipartisan Policy Center and chaired by the two of us, who together have eight decades of experience at the forefront of federal engagement with agriculture issues, the Project was launched in March 2006. Its aim has been to work directly with farmers, ranchers, and other stakeholders to forge bipartisan consensus around a new agenda for U.S. farm policy in the 21st century. It is our intent to put forward a series of recommendations that, taken together, can be implemented at a net savings to the federal government compared with the current Farm Bill. Specifically, our recommendations assume that increased demand for biofuels under an expanded renewable fuel standard will produce substantial savings in existing agriculture support programs, including elimination of the direct payment program, less reliance on countercyclical and loan deficiency payments, and more reliance on the marketplace.

Programs to sustain the nation's agricultural sector must necessarily evolve to reflect emerging budget pressures and new economic realities, while also being responsive to the larger concerns and interests of American taxpayers, consumers, and

utility ratepayers. Indeed, as taxpayers, consumers, and ratepayers themselves, farmers and ranchers are best served by well-designed policies that achieve equitable outcomes, do so in a fiscally responsible manner, and are carefully targeted to achieve maximum societal benefits at the lowest possible cost. Fortunately, the input gathered through this project from farmers and researchers points to promising opportunities for reforming current policies in ways that are responsive to broader public-interest objectives without in any sense diminishing the federal government's longstanding commitment to an economically secure agricultural base. The recommendations advanced here reflect the view that strategic investments in developing new market opportunities and in helping agricultural producers gain a larger stake in high-value-added enterprises can reduce farmers' need for current safety net programs in ways that are less susceptible to political uncertainty and international trade rules and that are revenue-neutral, in terms of overall federal spending. Four overarching themes connect these recommendations:

- **Securing a robust, economically vibrant future for American agriculture in the 21st century requires a more expansive and creative approach to farm policy.** A continued federal commitment to the financial security and stability of the nation's farm community is essential at a time when globalization, technological change, environmental concerns, high energy costs, international pressure to cut traditional subsidies, and continued urbanization all pose new challenges for agriculture. To help farmers respond effectively while continuing to undergird U.S. competitiveness, federal policy must evolve to encompass a broader set of issues and successfully leverage multiple synergies.
- **An emphasis on new markets and on increasing farmers' equity share in value-added enterprises provides the best foundation for expanding opportunity in rural communities.** Biofuels, renewable energy like wind power, carbon sequestration, and habitat preservation for recreation and hunting are just some examples of agriculture-related activities that can significantly augment and diversify future sources of income for America's farm families. Targeted policies are needed to increase farmers' stakes in the new wealth generated by these emerging markets.
- **Increasing the role of America's farms in energy production can be achieved at a net savings to the federal budget because increased demand for corn and other crops to serve the rapidly growing alternative-fuels market will naturally reduce outlays for traditional "safety net" programs.** New economic research suggests that explosive growth in ethanol production will lead to higher prices not only for corn, but also for soybeans and wheat, as acreage now in these crops is shifted to corn. These market shifts are expected to dramatically reduce countercyclical and loan deficiency payments for certain crops, potentially freeing billions of dollars each year for farm programs that have broad political support and that generate promising, and ultimately more self-sustaining, economic opportunities in the long run.
- **Federal action to establish a mandatory program to limit greenhouse gas emissions is sensible and will provide agricultural producers with significant new market opportunities.** The agriculture sector is in a unique position to lead in—and benefit from—efforts to address climate change. Expanded demand for biofuels is an obvious example, but ranch and farm lands are also well-suited for future development of renewable electricity sources (e.g., wind and solar power) and carbon sequestration.

The agriculture sector is in a unique position to lead in—and benefit from—efforts to address climate change.

Summary of Recommendations

Continue to provide economic stability through existing countercyclical programs, while investing in market-based opportunities for agriculture and addressing new sources of financial insecurity through a permanent disaster program:

- First, the core of the federal farm program must be a strong countercyclical program based on the two

countercyclical elements of the current farm bill: (1) a robust marketing loan program that treats all producers equally and (2) a partially decoupled countercyclical program. Individual farm benefits should be capped at $250,000 per year and eligibility to obtain benefits through more than one entity should be eliminated.

- Second, Congress should eliminate the direct payment program and redirect funds for this program—along with savings generated by reduced countercyclical and LDP payments for corn, wheat, and soybeans—to permanent disaster assistance and promoting new income-generating opportunities for farmers in markets such as biofuels, renewable electricity, carbon sequestration, and conservation.

…federal policies to promote renewable energy should encourage the siting of new projects on farm or ranch lands wherever possible.

- Third, Congress should establish a Value-Added Equity Creation Program to provide farmers and ranchers with no-interest revolving loans so that they can participate in high-value agriculture-related business opportunities, such as biofuels plants and wind projects. Producers should be eligible to participate if their primary occupation is farming and should be able to receive up to $100,000 in interest-free loans for equity investments in qualifying value-added enterprises (as certified by the U.S. Department of Agriculture (USDA)).
- Finally, in recent years, Congress has frequently passed annual emergency spending bills to provide agricultural producers with disaster assistance. While these measures have provided important relief to farmers and ranchers, they have been ad hoc in nature and off budget. As a result, Congress may decide to establish a permanent disaster assistance program, administered by USDA, to provide ranchers and farmers with assistance for clearly defined disaster conditions. If so, we recommend that Congress replace the current system of ad hoc off-budget emergency supplemental spending bills, make the permanent disaster assistance program on-budget as part of the Farm Bill, and include a reasonable benefit cap of $250,000 per farm or ranch in any single year. If a reasonable benefits cap is imposed, net federal outlays for disaster assistance should be reduced compared with the current off-budget approach.

To promote biomass-based alternative liquid fuels, Congress should:

- **Expand and extend the recently-adopted renewable fuels standard (RFS)** to reach at least 10 billion gallons per year by 2010, 30 billion gallons per year by 2020, and 60 billion gallons per year by 2030, as proposed in bipartisan legislation introduced in the U.S. Senate. This step would lead to expansion of biofuels markets beyond the E-10 market and spur new investment in the next generation of advanced biofuels technologies, such as cellulosic ethanol.
- **Promote the use of higher blends of ethanol** in the existing fleet of automobiles by instructing the Environmental Protection Agency to conduct analysis of the viability of using higher blends of ethanol (including E-15, E-20, E-30, and E-40) in the existing fleet of automobiles by January 1, 2009.
- **Extend the existing volumetric ethanol excise tax credit (VEETC) to 2020 while simultaneously restructuring this program in ways that account for expected growth in corn ethanol production under an expanded national RFS.** After the current tax incentive authorization expires in 2010, Congress should look for ways to ensure that the cost of the tax credit—in the context of other policies and expected ethanol production volumes—remains acceptable, while ensuring that new and innovative biofuels project are provided the support they need to be successful. Among the criteria that Congress

should use to design the post-2010 biofuels tax credits are:

1. Limiting the overall cost of the tax incentives to the government;
2. Encouraging expansion of the industry by ensuring that investments in new plants and recently-built plants can be fully amortized;
3. Rewarding energy-efficient and low-carbon emitting technologies;
4. Ensuring that pioneering processes, such as those that convert cellulosic feedstocks like corn stover and switchgrass to ethanol, are economically competitive with fossil fuels;
5. Encouraging farmer ownership of ethanol plants;
6. Balancing domestic tax credits with an import duty of similar size, so that U.S. taxpayers do not subsidize ethanol imports to the detriment of American producers.

- **Extend the small producer renewable fuels tax credit beyond 2008 for plants that are at least 40 percent locally-owned and for cellulosic ethanol plants.**

- **Consolidate all cellulosic biofuels loan guarantee programs into a single program at USDA and establish an energy security trust fund to provide consistent funding for that program.** Successfully commercializing the production of ethanol and other fuels from cellulosic (i.e., woody or fibrous) plant materials would dramatically expand the potential contribution of biofuels in terms of displacing current petroleum use and associated carbon emissions. Implementing many existing loan guarantee programs through three separate federal agencies makes little sense. USDA has considerable experience in implementing loan guarantee programs and expertise in evaluating biofuels projects through its Office of Energy. Therefore, Congress should consolidate all federal biofuels grant and loan guarantee programs at USDA and establish a national energy security trust fund to provide at least $1 billion per year in loan guarantees and grants to promote necessary advances in production technology and bio-science.

- **Establish a demonstration cellulosic biofuels feedstock program.** Congress should establish a new set-aside program to demonstrate how the cultivation and harvesting of cellulosic feedstocks could be accomplished in an economically attractive manner. Following the model of several existing programs, the 2007 Farm Bill should provide a modest payment to landowners who convert existing cropland to grow cellulosic biofuel feedstocks for nearby cellulosic biofuels plants in ways that improve wildlife habitat, reduce soil erosion, and protect water quality. New lands to be set aside under such a program should be capped at 500,000 acres for the duration of the 2007 Farm Bill.

- **Establish policies to encourage a rapid increase in the number of flexible fuel vehicles sold in the United States and the installation of E-85 pumps and blender pumps at gasoline stations.** For example, we recommend extending the existing tax credit for installing E-85 refueling stations and redesigning it to provide relatively greater benefits in the near-term to encourage more rapid deployment of E-85 infrastructure. We also recommend clarifying that blender pumps be eligible for the tax credit, since in the long run it will make more sense to install blender pumps that are capable of dispensing a range of ethanol blended fuels. Congress also should consider more attractive expensing and accelerated depreciation options to encourage installation of E-85 and blender pumps in lieu of tax credits.

To promote renewable electricity production and other renewable energy projects on farms and ranches, Congress should:

- **Establish a national renewable portfolio standard (RPS) along with complementary policies to promote maximum development of cost-effective renewable energy potential on agricultural lands.** Such policies to promote renewable energy have been adopted by 21 states and the District of Columbia and Congress should now take action to adopt a portfolio requirement at the federal level. Moreover, federal policies to promote renewable energy should encourage the siting of new projects on farm or ranch lands wherever possible. Given that the use of these lands would be far preferable to new development in wilderness areas and would simultaneously provide important economic benefits for rural communities, an appropriate policy goal would be to satisfy at least two-thirds of a national RPS with renewable energy production on agricultural lands. In addition, a federal RPS should be designed to complement and not pre-empt any state requirements (which may be more ambitious) and should apply equally to all large retail electricity providers. (To simplify implementation requirements and to address supply and price concerns, it may be appropriate to exclude rural electric coops and small municipal utilities.)
- **Expand and strengthen existing programs outside the Farm Bill that promote renewable energy development and related technology advances.** To provide investment certainty, existing renewable-energy production tax credits (PTCs) should be extended for ten years and funding for related research, development, demonstration, and early deployment efforts should be increased. In addition, such programs should be modified so that incentives can be taken against non-passive income. The Community Renewable Energy Bonds (CREBs) program should be extended and expanded, with a substantial sum set aside for rural electric cooperatives and municipal utilities.
- **Establish a Rural Community Renewable Energy Bonds program to provide a federal incentive for local private investment in renewable energy to complement the PTC and CREBs programs.** This new initiative would be limited to projects of

not more than 40 MW, where at least 49 percent of the project is owned by entities resident within 200 miles of the project site.

- **Expand the capacity of the existing federal power administration transmission system.** The federal power marketing administrations (PMAs) own and manage a vast network of existing power lines, which should be substantially expanded to provide the additional capacity needed to tap cost-effective renewable energy resources. Congress should direct the federal power administrations to pursue this objective under a structure in which non-benefiting PMA customers do not shoulder the cost and preference is given for system investments that maximize promising opportunities for renewable energy development on agricultural lands. Priority should be placed on the expansion of the Western Area Power Administration (WAPA) and Bonneville Power Administration (BPA) transmission systems. The PMAs also should be authorized and encouraged to enter into partnerships with non-federal parties for the siting, planning, and construction of transmission lines; the participation of PMAs can streamline siting by avoiding multiple state siting authorities.
- **The Department of Energy (DOE) should designate the Heartland Transmission Corridors "National Interest Electric Transmission Corridors" pursuant to the Energy Policy Act of 2005.** Federal assistance in the form of an expanded role for WAPA as a facilitator for planning and investment, and a 20 percent matching investment from the federal government would go a long way toward addressing cost and siting hurdles, encouraging state cooperation, and ensuring that needed transmission system enhancements are implemented.
- **Congress should authorize $1 billion per year for five years to provide tax-exempt bonds for the construction of transmission facilities (or the expansion of existing facilities) where such construction or expansion is cost-effective and offers substantial public policy benefits in terms of facilitating the development of clean, domestic renewable resources.** Under such a program, loans would be provided by eligible government entities to qualified private entities seeking to finance eligible transmission infrastructure. Such bonds would assure the availability of financing for transmission at significantly lower cost than presently available in the market. They could be used both for new transmission and for upgrades to existing facilities (for example, to address transmission constraints in west Texas and Minnesota, where substantial wind development opportunities exist, or to access renewable energy projects anticipated as a result of the Rocky Mountain Area Transmission Study (RMATS) in the Western Interconnect. In addition, current private use restrictions applicable to projects that receive tax-exempt bonds should be reviewed to assess whether they create unnecessary additional hurdles to investment.
- **Explore further opportunities for an expanded federal role in directly facilitating the implementation of, and providing resources for, investments to enhance grid capacity and to promote a more efficient, seamless, and reliable transmission system nationwide.**
- **Reauthorize and expand USDA's Energy Audit and Renewable Energy Development Program** under Section 9005 of the 2002 Farm Bill. This program to assist farmers, ranchers, and rural small businesses in becoming more energy efficient and in using renewable energy technology and resources has never been funded. It should be reauthorized with a goal of performing audits of 25 percent of all farms and ranches over the time horizon covered by the next Farm Bill and funds sufficient to achieve that goal should be appropriated in the future.

…agricultural producers should have the opportunity to participate fully in the carbon markets that will be created under a greenhouse gas trading program.

- **Reauthorize and expand USDA's Rural Development Business Renewable Energy and Energy Efficiency Program** (Section 9006 of the 2002 Farm Bill). This program currently provides a modest number of grants—$23 million per year—to support renewable energy and energy-efficiency projects. Future funding should be scaled up over the next 5 years to at least $500 million per year and the program should be expanded to enable participating agencies to provide grants for feasibility studies and loan guarantees for project development. As long as feasibility studies are accurately performed, the cost to the federal government of providing loan guarantees for up to 75 percent of project costs should be fairly small. In addition, Congress should consider modifying the program to (1) increase loan guarantees for cellulosic ethanol

facilities to at least $100 million per project, and $25 million for other projects, (2) create a rebate program to streamline the application process for smaller, standardized projects by reducing the paperwork burden, and (3) expand eligible applicants to include agricultural operations in non-rural areas (such as greenhouses) and schools.

To promote markets for carbon sequestration and other cost-effective greenhouse-gas mitigation measures on farm and ranch lands, Congress should:

TABLE I.A
NET FEDERAL GOVERNMENTAL SAVINGS ASSOCIATED WITH RECOMMENDATIONS

New Savings	
Eliminate Direct Payment Program	- $5 billion per year
Savings in CC and LDP	- $4 billion per year
Total New Savings	**- $9 billion per year**
New Costs	
Extend PTC [1]	$0
Carbon Sequestration Program [2]	$0
No-Interest Revolving Loans to Producers	$1.5 billion per year
Establish an energy security trust fund	$1 billion per year
Establish a 500,000 acre cellulosic feedstock program	$25 million per year
Authorize tax-exempt bonds to fund transmission	$250 million per year
Expand Farm Bill Section 9005	$25 million per year
Expand Farm Bill Section 9006	$500 million per year
CRP at 40 million acres	$100 million per year
WRP at 5 million acres	$500 million per year
GRP at 5 million acres	$100 million per year
FRPP at $300 million per year	$300 million per year
Open Fields	$20 million per year
Total New Costs	**$4.320 billion per year**
Net Savings	**$4.680 billion per year**[3]

[1] Since Congress already reliably extends the PTC annually or bi-annually, there is no additional cost assumed for this recommendation.
[2] The costs associated with implementing this program are assumed to be paid by revenues generated by an annual auction of carbon credits under a mandatory nationwide greenhouse gas cap.
[3] Does not include costs to expand the Conservation Security Program, the Clean Renewable Energy Bonds, Rural Community Renewable Bonds, and federal transmission capacity, since no recommendation was made regarding the specific amount by which each of these programs should be expanded. Nor does it include savings associated with replacing off-budget supplemental disaster assi

- **Establish a national, mandatory, market-based program to reduce economy-wide greenhouse gas emissions that provides substantial market opportunities for cost-effective carbon sequestration on farm and ranch lands.** Specifically, agricultural producers should have the opportunity to participate fully in the carbon markets that will be created under a greenhouse gas trading program. To facilitate this participation, priority must be given to establishing robust, well-defined protocols for measuring and verifying carbon reductions achieved through terrestrial sequestration.
- **Establish tax incentives, such as federal tax refunds for local and state property taxes, for farmers and ranchers who enroll land in a carbon trading program that works in tandem with entities that buy, sell and trade carbon credits.**
- **Direct USDA to work with other state and federal agencies on continued economic and technical research on different options for sequestering carbon and on better methods of documenting sequestration for market participation.**

To advance widely supported environmental, habitat-preservation, and open-space objectives while creating additional income-generating opportunities for farmers and maximizing potential business opportunities related to hunting, fishing, and other forms of outdoor recreation, Congress should:

- **Expand existing conservation programs:**
  1. Expand the Conservation Reserve Program at 40 million acres;
  2. Expand the Wetlands Reserve Program at 5 million acres, with annual enrollment capped at 250,000 acres per year;
  3. Expand the Grasslands Reserve Program at 5 million acres, with annual enrollment capped at 500,000 acres per year;
  4. Increase funding for the Farm and Ranch Lands Protection Program to at least $300 million per year.
  5. Implement the Conservation Security Program on a nationwide basis on all working lands.
- **Enact "Open Fields Bill" to provide $20 million per year in federal funds to supplement state "walk in" programs that give farmers and ranchers financial incentives to expand public access to their lands.**

I. INTRODUCTION

America's farmers and ranchers *face a future of unprecedented challenges and opportunities. Globalization, technological change, trade issues, federal budget constraints, global warming, high energy costs, land-development pressures, and environmental and food safety concerns are all likely to have a profound impact on rural communities and on future prospects for sustaining a prosperous and vibrant farm economy. At the same time, new markets are opening to farmers that already are paying enormous dividends. Investments in biofuels projects and wind farms, as well as the generation of carbon credits, are providing farmers and ranchers with new sources of income that are* **transforming the rural American economy.**

The 21st Century Agriculture Policy Project was motivated by a recognition that this rapidly changing landscape calls for a more expansive and creative approach to national farm policy. Sponsored by the Bipartisan Policy Center and chaired Senators Bob Dole and Tom Daschle, who together have eight decades of experience at the forefront of federal engagement with agriculture issues, the Project was launched in March 2006. Its aim has been to work directly with farmers, ranchers, and other stakeholders to forge bipartisan consensus around a new agenda for U.S. farm policy in the 21st century.

This report describes project results to date and sets forth a number of specific recommendations based on extensive dialogue with members of the farm community and other interested and knowledgeable parties. In particular, the recommendations draw on insights and suggestions generated at a series of meetings that we convened in Washington D.C. (March 15, 2006), Manhattan, Kansas (June 30, 2006), and Brookings, South Dakota (July 18, 2006). Conclusions and recommendations presented in this report were further informed by several new analyses commissioned by the project and summarized in later sections, which explore a range of issues. Commissioned papers address a range of topics, including:

- **Impacts of Current WTO Negotiations:** This paper examines the effects of international trade rules and ongoing negotiations under the auspices of the World Trade Organization on U.S. farm programs. It was performed by Paul Drazek and Craig Thorne of firm of DTB Associates, LLP.
- **Potential Design and Benefits of a National Agricultural Carbon Sequestration Program:** Options for designing a carbon sequestration program by Dr. Chuck Rice of the Consortium for Agricultural Soil Mitigation of Greenhouse Gases at Kansas State University.
- **Designing Federal Policy to Position U.S. Agriculture for Commercial Prosperity in the 21st Century:** Economic analysis of the impacts of historic and current agriculture policies on planting decisions and market prices by Dr. Bruce Babcock of Iowa State University. Includes policy recommendations, with respect to safety net programs, conservation, biofuels and other issues, aimed at producing a favorable combination of market prices and efficient planting decisions in the future.
- **Renewable Fuels Expansion Study:** The University of Tennessee conducted a study of the potential for expanding biofuels production in the United States. This study was co-sponsored by the Governors' Ethanol Coalition.
- **Farmer-Owned Bioenergy Corn Reserve:** Jointly commissioned with the National Farmers Union, and the American Coalition for Ethanol, this report, by Dr. Daryll E. Ray, Director of the Agriculture Policy Analysis Center at the University of Tennessee, explores the potential design of a strategic grain reserve for biofuels production. The analysis estimates maintenance costs for such a reserve and examines potential impacts on corn prices.

Copies of these studies can be found at the project website at: www.21stcenturyag.org. In addition, Dr. Bruce McCarl of Texas A&M evaluated the economic impacts of a mandatory program to limit greenhouse gas emissions on U.S. farmers. This analysis weighs increased direct and indirect energy costs under such a program against the economic benefits associated with generating carbon credits for carbon sequestration, expanding biofuels production and renewable energy development on agricultural land, and investing in energy conservation. Dr. McCarl's work is summarized in the text of the report.

In our experience, farmers and ranchers are resilient and extraordinarily adept at recognizing and exploiting the opportunities that come with change.

Importantly, the recommendations contained in this report, taken together, are designed to be revenue-neutral and to avoid further stresses on the federal budget. New research conducted for this project suggests that existing policies to promote biomass-based fuels such as ethanol will lead to higher prices for agricultural commodities like corn, soybeans, and wheat, thereby naturally reducing dependence on countercyclical and loan deficiency payment (LDP) programs. This effect is expected to free substantial resources previously budgeted for this purpose to be used for a new generation of farm programs that have broader political support and that lead to more promising and self-sustaining income streams in the long run. In fact, two broad recommendations of this report—eliminating the direct payment program and extending the renewable fuel standard—will save roughly $9 billion per year; the net savings associated with all recommendations amounts to over $4 billion per (see table I.A). In short, these recommendations assume that savings generated by eliminating the direct payment program and from ongoing reductions in countercyclical and LDP payments will be used to pay for the new investments proposed in this report.

It should also be noted that some important areas of agriculture policy are outside the scope of this project. Concerns about food safety and vulnerability to bio-terrorism, for example, have drawn increased attention in recent years and clearly represent significant

policy challenges in their own right; these and other issues may warrant policy changes that are not addressed in this report.

The report is organized into two additional sections. Section II, "A Safety Net for the 21st Century," reviews the history of current safety net programs and makes recommendations for an updated safety net that both accounts for higher commodity prices and provides new opportunities for farmers to invest in value-added enterprises. Section III, "New Markets for American Agriculture," examines these new market opportunities in some detail, focusing particular attention on biofuels, renewable electricity production, carbon sequestration, land conservation and outdoor recreation recreational opportunities.

TABLE I.A
NET FEDERAL GOVERNMENTAL SAVINGS ASSOCIATED WITH RECOMMENDATIONS

New Savings	
Eliminate Direct Payment Program	- $5 billion per year
Savings in CC and LDP	- $4 billion per year
Total New Savings	**- $9 billion per year**
New Costs	
Extend PTC[4]	$0
Carbon Sequestration Program[5]	$0
No-Interest Revolving Loans to Producers	$1.5 billion per year
Establish an energy security trust fund	$1 billion per year
Establish a 500,000 acre cellulosic feedstock program	$25 million per year
Authorize tax-exempt bonds to fund transmission	$250 million per year
Expand Farm Bill Section 9005	$25 million per year
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Total New Costs	**$4.320 billion per year**
Net Savings	**$4.680 billion per year**[6]

[4] Since Congress already reliably extends the PTC annually or bi-annually, there is no additional cost assumed for this recommendation.
[5] The costs associated with implementing this program are assumed to be paid by revenues generated by an annual auction of carbon credits under a mandatory nationwide greenhouse gas cap.
[6] Does not include costs to expand the Conservation Security Program, the Clean Renewable Energy Bonds, Rural Community Renewable Bonds, and federal transmission capacity, since no recommendation was made regarding the specific amount by which each of these programs should be expanded. Nor does it include savings associated with replacing off-budget supplemental disaster assi

The Changing Landscape for American Agriculture

Changing consumer values, market demands, competitive pressures, trade rules, and demand for environmental services will dramatically affect the future success of American agriculture. In our experience, farmers and ranchers are resilient and extraordinarily adept at recognizing and exploiting the opportunities that come with change. As Congress drafts a new Farm Bill, as new state and federal energy policies are written, as international trade rules are negotiated, and as new clean air and conservation goals are adopted, the nature of farming and ranching will change to meet these challenges. In many respects, the farms of the future will be more diverse businesses, providing an array of goods and services that previous generations never contemplated. Such diversification will not only provide new sources of income, it will encourage more young people to stay on the farm, pursuing innovative enterprises and practicing land conservation ethics that have been the hallmark of American agriculture.

Some of the most promising new markets for American agriculture involve a greater role in providing clean, secure, domestically-produced forms of energy. In addition, farmers and ranchers have an opportunity to benefit from the growing value the public places on environmental quality, habitat preservation, open space, and outdoor recreation. Implementing the recommendations in this report will create an enduring source of financial stability for the nation's agricultural producers while simultaneously advancing energy security, conservation, and environmental objectives that are important to all Americans. Farmers and ranchers understand the challenges that confront agriculture in the 21st century and are eager to embrace a more expansive vision of federal farm policy, commensurate with those challenges.

Re-imagining the Federal Role in Agriculture Policy

Programs to sustain the nation's agricultural sector must necessarily change to reflect new and emerging pressures and economic realities. Fortunately, the input gathered through this project from farmers and researchers alike points to promising opportunities for reforming current policies in ways that are responsive

to these pressures without in any sense diminishing the federal government's longstanding commitment to an economically secure agricultural base. The recommendations advanced here reflect the view that strategic investments in developing new market opportunities and in helping agricultural producers gain a larger stake in high-value-added enterprises can reduce farmers' need for current safety net programs in ways that are less susceptible to political uncertainty and international trade rules and that are revenue-neutral, in terms of overall federal spending. Specifically, the recommendations that follow are connected by four overarching themes:

Some of the most promising new markets for American agriculture involve a greater role in providing clean, secure, domestically-produced forms of energy.

- **Securing a robust, economically vibrant future for American agriculture in the 21st century requires a more expansive and creative approach to farm policy.** A continued federal commitment to the financial security and stability of the nation's farm community is essential at a time

when globalization, technological change, environmental concerns, high energy costs, international pressure to cut traditional subsidies, and continued urbanization all pose new challenges for agriculture. To help farmers respond effectively while continuing to undergird U.S. competitiveness, federal policy must evolve to encompass a broader set of issues and successfully leverage multiple synergies.

- **An emphasis on new markets and on increasing farmers' equity share in value-added enterprises provides the best foundation for expanding opportunity in rural communities.** Biofuels, renewable energy, carbon sequestration, and habitat preservation for recreation and hunting are just some examples of agriculture-related activities that can significantly augment and diversify future sources of income for America's farm families. Targeted policies are needed to increase farmers' stakes in the new wealth generated by these emerging markets.
- **Increasing the role of America's farms in energy production can be achieved at a net savings to the federal budget because increased demand for corn and other crops to serve the rapidly growing alternative-fuels market will naturally reduce outlays for traditional "safety net" programs.** New economic research suggests that explosive growth in ethanol production will continue to lead to higher prices not only for corn, but also for soybeans and wheat, as acreage now in these crops is shifted to corn. These market shifts are expected to dramatically reduce countercyclical and loan deficiency payments for certain crops, potentially freeing billions of dollars each year for farm programs that have broad political support and that generate promising, and ultimately more self-sustaining, economic opportunities in the long run.
- **Federal action to establish a mandatory program to limit greenhouse gas emissions is sensible and will provide agricultural producers with significant new market opportunities.** The agriculture sector is in a unique position to lead in—and benefit from—efforts to address climate change. Expanded demand for biofuels is an obvious example, but ranch and farm lands are also well-suited for future development of renewable electricity sources (e.g., wind and solar power) and carbon sequestration. In many cases, these new uses co-exist with traditional agricultural activities, augmenting rather than supplanting other sources of farm income and helping to minimize any added pressure on finite land resources.

II. A SAFETY NET *for the 21st Century*

Today American farmers and *ranchers confront a rapidly changing economic landscape that presents new challenges and opportunities. Mounting federal budget deficits and international trade rules are putting pressure on long-standing price-support and safety-net programs. Energy prices have increased dramatically in recent years, just as urgent environmental concerns are coming to the fore. At the same time, renewable energy projects, such as biofuels plants and wind projects are providing new sources of income for producers and higher commodity prices are ushering in a new era of sustained profitability. In the midst of these changes, the farm sector as a whole is undergoing deep structural shifts. The American Farm Bureau's 2006 report, "Making American Agriculture Productive and Profitable," predicts that the next 15 years will bring a* **number of momentous changes:**

- Future government support for agriculture will be structured very differently than it is today. In 2002, 143,000 farming operations produced 75 percent of the value of all agricultural output. It took 1.9 million operations to produce the remaining 25 percent. According to the report, however, by 2019, there will be more large farms and more small farms, but the number of mid-sized farms will have decreased drastically;
- America will have fewer farms producing a larger percentage of total U.S. food and fiber, while there will be growth in the number of smaller farms;

- Farmers will be more dependent on rural communities than rural communities will be dependent on agriculture;
- Global trade will be driving agricultural profitability, because more than 96 percent of the world's population will be living outside the United States;
- More farmers and ranchers will have learned to produce what they can sell and not simply sell what they produce;
- Market forces will be driving the implementation of more environmental practices;
- The current structure of farm programs will no longer prevail.

Current demographic trends are likely to have profound long-term effects on rural communities and on the balance of political support for agricultural programs. As the U.S. population becomes increasingly concentrated along the coasts and in a few high-growth areas, arguments for investing public resources in the farm sector will increasingly need to appeal to broad policy objectives that are shared by urban and rural constituents alike. Since the agricultural sector provides the underpinning of a vibrant U.S. economy by supplying a safe, abundant, diverse, affordable food and fiber supply, it is in the government and society's best interests to ensure agricultural sustainability. Increasingly, however, society will come to rely on the agricultural sector for renewable energy and environmental benefits as well. To adapt to these shifts and succeed in an increasingly competitive global market, farmers and ranchers must be empowered to leverage 21st century challenges into new business opportunities. A flourishing farm sector, in turn, has much to offer the nation as a whole: from maintaining a strong economic base in rural communities to providing clean, domestic sources of energy and preserving healthy natural ecosystems. Remaining sections of this chapter discuss the outlook for existing farm support programs in light of emerging trade and budget pressures, and recommends a safety net that combines countercyclical elements with a permanent disaster program and a new program to empower producers to invest in value-added enterprises.

The Changing Outlook for Current Safety Net Farm Programs

Historically, U.S. agricultural policy has focused on securing the nation's domestic food supply, in part by providing a safety net to help agricultural producers through periods of low commodity prices. The goal of current farm policy—to help farmers withstand times of low prices—is the same as it was over 70 years ago when Congress passed, and President Franklin Roosevelt signed into law, the Agricultural Adjustment Act of 1933.

Increasingly, however, society will come to rely on the agricultural sector for renewable energy and environmental benefits as well.

Agriculture is unique in that unpredictability in the marketplace outside of farmers' control leaves producers vulnerable to significant price swings. According to Iowa State University Economist Bruce Babcock, agricultural prices will continue to be affected by "unexpected changes in production and demand" in the future.[7] The Farm Bill's income safety net is designed to help protect producers from the impacts of production variability and demand shocks.

Production variability is the likelihood that actual crop yields will be above or below average in a given year. This variability has a direct impact on price; an increase in U.S. corn yields will cause a decline in corn prices. While producers have a general under-

[7] *Where to with Farm Policy? Lessons from the Past and Options for a Bio-Fueled Future,* by Bruce A. Babcock, Iowa State University, Prepared for the 21st Century Agriculture Policy Project, p. 11.

standing of how many acres will be planted in a given year, there is no accurate way to gauge what yields will be at harvest time, leaving pricing decisions to chance.

Demand for U.S. agricultural products can also be affected by significant market shocks. The Asian financial crisis in the late 1990s in conjunction with a high-valued U.S. dollar caused demand for U.S. commodities to decline, which in turn led to significant price reductions in for U.S. producers. Similarly, President Carter's 1979 embargo on grain exports to the Soviet Union reduced demand for U.S. wheat and resulted in lower prices.

From Past to the Present

In 1995, when Congress was writing the Farm Bill that would replace the 1990 version, commodity prices were above the income safety net levels in the 1990 bill and were expected to remain high at least through 1997. This meant that an extension of the 1990 bill would result in no payments to producers. Instead of leaving the counter-cyclical program of the 1990 bill in place and using the budget savings for other priorities, the architects of the 1996 Farm Bill replaced the counter-cyclical deficiency payment mechanisms of the 1990 bill with fixed, decoupled payments called Agricultural Marketing Transition Act (AMTA) payments. The idea was that producers would receive these direct payments regardless of price as a means to transition farmers from government support to an era of free markets.

Unfortunately, as noted above, the Asian financial crisis combined with a strong U.S. dollar caused a significant decline in worldwide demand for U.S. products and commodity prices plummeted in the late 1990s. Because the 1996 Farm Bill did not include any real counter-cyclical mechanism to respond when prices were low, Congress reacted by passing a series of multi-billion dollar ad hoc economic disaster packages in 1998, 1999, 2000, and 2001 to compensate producers for low prices.

When crafting the budget for the 2002 Farm Bill, Congress included additional funding to fill this hole in the 1996 legislation. Specifically, the 2002 Farm Bill included significantly more counter-cyclical safety-net measures, such as increased marketing loan rates and a new program that only pays producers when prices fall below target levels.

The 2002 Farm Bill authorized $73.5 billion in new spending compared to the previous Farm Bill. The Congressional Budge Office (CBO) projected that the total cost of this legislation over the ten-year period from 2002 to 2012 would be $869.3 billion. Of that amount, 72 percent (or $626.8 billion) was dedicated to food and nutrition assistance programs. The remaining $242.5 billion was dedicated to commodity, conservation, trade, credit, rural development, research, forestry and energy programs.[8] Of the $73.5 billion in additional spending authorized under the 2002 Farm Bill, $47 billion was directed to commodity programs, $17 billion was directed to new conservation initiatives (an 80 percent increase), $6.4 billion was directed to new nutrition initiatives, $1.3 billion was directed to research, $1.1 million was directed to trade programs, $870 million was directed to rural development, $405 million was directed to energy initiatives, and $100 million was directed to forestry initiatives.

COMPONENTS OF THE INCOME SAFETY NET

Direct Payments: Fixed, decoupled payments paid to producers based on 85 percent of historical base and yield figures regardless of price. Payments are not tied to current day production or price information (i.e., corn producers receive $0.28 per bushel on 85 percent of their historical base and yield figures regardless of price, whether corn is selling at $1.85 per bushel or $3.09 per bushel).

Marketing Assistance Loans (and LDPs): Payments on all current production when the loan rate specified in law exceeds the posted county price or prevailing world price for a commodity. For example, with a corn loan rate of $1.95 per bushel and a corn price of $1.85, producers would receive $0.10 per bushel on all production. When corn prices are $1.96 per bushel or above, producers would receive no payment under this program.

Counter-cyclical Payments: Payments that make up the difference between a crop's average market price plus the fixed decoupled payment, and its "target price." Payments are paid based on 85 percent of each farm's base acres and crop yields. The 2002 bill allowed producers to update base and yields for counter-cyclical payments. For example, with a corn target price of $2.63 per bushel and corn selling at $1.95 per bushel, producers would receive a payment of $0.40 per bushel on 85 percent of their counter-cyclical base and yield (target price minus market price and direct payment). With corn selling at $3.09 per bushel, producers would not receive a counter-cyclical payment but would still receive the $0.28 per bushel direct payment.

[8] Congressional Budget Office, Cost Estimate for H.S. 2646, the Farm Security and Rural Investment Act of 2002, May 22, 2002.

Central to the 2002 Farm Bill was an effort to make the commodity title respond better to periods of low prices. Of the $47 billion authorized for commodity programs, Congress used $31 million to improve the income safety net for so-called program crops, which relies on three basic mechanisms: direct payments, the marketing loan program, and counter-cyclical payments. While producers receive direct payments regardless of price, the marketing loan deficiency payments and counter-cyclical payments respond to market conditions. Producers receive these payments when prices are low, but not when prices are high.

In large part, producers are pleased with the components of the 2002 Farm Bill and several commodity and farm organizations have called for extending the existing law.

New Challenges

Despite strong political support for the 2002 Farm Bill, some have cited federal budget constraints and efforts to liberalize international trade as reasons for changing the structure of U.S. agricultural support programs.

Federal Budget Constraints

Ongoing large annual federal budget deficits are generating pressure for change in the structure of agricultural safety net programs. The United States ran a $260 billion budget deficit in 2006, increasing the nation's total debt to $8.5 trillion.[9] This is in stark contrast to the budget surpluses that existed in 2002 when the last Farm Bill was written. The $73.5 billion in additional spending for the 2002 Farm Bill allowed Congress to significantly improve the income safety net while at the same time providing an unprecedented increase in funding for conservation, rural development, trade, forestry and energy programs. Ultimately, what will matter most to producers will not be the cost of the commodity title programs per se, but instead the level of protection provided by the income safety net.

[9] United States Senate Budget Committee, personal communication, Jonathan Lehman.

The 2002 Farm Bill illustrates this point. While the CBO projected that spending on commodity and conservation programs would total $73 billion from 2002 through 2006, actual expenditures totaled $64.8 billion because farm prices were higher than CBO originally forecast.[10] In fact, aggregate annual federal outlays for these programs in recent years have fluctuated between $6.5 billion and $16 billion.[11]

Today, commodity prices have improved significantly as a result of increased demand from the expansion of the ethanol industry in the United States and prices are projected to remain above current income safety net levels over the life of the next Farm Bill.[12] According to Dr. Babcock, the rapid expansion of the ethanol industry will increase prices for corn, other feed grain, and wheat. Higher corn prices will likely also lead to an increase in the acreage used for corn cultivation, reducing the land available for soybean, wheat, and cotton production. In fact, at current corn prices above $4 per bushel, acreage devoted to corn cultivation is expected to expand by an additional 10 million acres in 2007 compared with 2006.

Lower production of wheat and soybeans will increase market prices for these commodities above the levels they would otherwise be. As a result, it is expected that the commodity title will continue to cost less than projected in 2002, when the CBO estimated, that commodity title spending would total $124.8 billion for the period 2002–2011. The March 2007 CBO update estimates that spending on Farm Bill commodity crop programs will be

[10] Comparison of CBO estimate of Farm Bill at passage of the bill versus March 2006 baseline.

[11] *Where to with Farm Policy? Lessons from the Past and Options for a Bio-Fueled Future,* by Bruce A. Babcock, Iowa State University, Prepared for the 21st Century Agriculture Policy Project.

[12] *Where to with Farm Policy? Lessons from the Past and Options for a Bio-Fueled Future,* by Bruce A. Babcock, Iowa State University, Prepared for the 21st Century Agriculture Policy Project, p. 32.

$34 billion less than CBO estimated only one year earlier. Most of these savings will result from lower federal counter-cyclical payments and marketing loan outlays due to higher market prices for corn, wheat, and soybeans. If commodity futures prices "give an accurate portrayal of what price levels will be through the next farm bill then current commodity programs (except for the direct payment program) will not result in any payments for farmers."[13] According to Ugarte et al., Congress can achieve $100 billion in farm program savings over the next quarter century by enacting a new, more aggressive renewable fuel standard.

This report explicitly recognizes the budget pressures facing lawmakers who will be writing the new Farm Bill and proposes a plan that will produce cumulative gross savings of $9 billion per year and more than $4 billion per year in net savings (see table I.A). Two recommendations account for those savings:

- Eliminating the direct payment program will provide $5 billion per year in savings;[14] and
- Adopting a new renewable fuel standard that will require the use of at least 60 billion gallons of biofuels by 2030. It is estimated that this policy will reduce safety net outlays by an average of $4 billion per year over the next 25 years.[15]

These savings should be invested in a new generation of policies for rural America that have broader political support and that lead to more self-sustaining, market-based sources of income in the long run.

The Merits of Revenue Insurance

While a new World Trade Organization (WTO) agreement on agriculture subsidies and trade barriers is not likely prior to passage of the next Farm Bill, there is still concern that U.S. agricultural programs will come under WTO scrutiny and, in particular, that there will be an increase in WTO dispute settlement cases aimed at U.S. crop subsidy programs. The combination of (1) the suspension of the Doha Round negotiations; (2) the expiration of the WTO Peace Clause which provided protection for actionable subsidies provided they met certain compliance conditions; and (3) Brazil's successful challenge to the U.S. Step 2 cotton program have increased anxiety that U.S. commodity programs may come under further challenge.

Under WTO rules, after expiration of the peace clause, an agricultural subsidy may be challenged based on claims of "adverse effects" in agricultural markets. Successful challenges would likely result in orders to eliminate or amend the programs in question to remove their adverse effects or to make compensatory payments to the challenging country. According to the Congressional Research Service, "when measured against WTO criteria, all major U.S. subsidized crops … appear potentially vulnerable to WTO legal challenges."[16]

In the light of continued international pressure on popular U.S. safety net features, such as the loan deficiency payment program, some farm organizations have begun to consider alternatives that could better withstand challenges from developing countries under WTO rules. One such proposal is to establish a revenue insurance program that would not be linked to the production of particular farm commodities like the current safety-net programs. Instead, payments would be based on meeting certain thresholds for loss of income or revenue.

Higher corn prices will likely also lead to an increase in the acreage used for corn cultivation, reducing the land available for soybean, wheat, and cotton production.

Proponents of this concept suggest that because payments would not be tied to the production of any particular commodity, they would be more favorably regarded under international trade agreements. Proponents also suggest that revenue insurance programs could be applied to a wider variety of farming situations including non-program crop producers.

Concern exists, however, about the complexity and cost of establishing such a system. The USDA's

[13] *Ibid.*

[14] *Where to with Farm Policy? Lessons from the Past and Options for a Bio-Fueled Future,* by Bruce A. Babcock, Iowa State University, Prepared for the 21st Century Agriculture Policy Project, p. 35.

[15] Ugarte et al. 2006.

[16] Randy Schnepf and Jasper Womach, Potential Challenges to U.S. Farm Subsidies in the WTO: A Brief Overview, CRS Report for Congress, October 25, 2006, p. 6.

Economic Research Service has stated "[t]he complexity and variety of U.S. farm operations suggest that, though farm income is a simple concept, the factors that determine income for a particular farm are complex." They conclude that "the feasibility of making these programs the main farm safety net is uncertain."[17]

We believe that revenue insurance proposals should continue to be studied and deserve to be considered for inclusion in the new Farm Bill on a limited pilot basis. Such programs should be explored as potential additions to the current income safety net programs until there is greater certainty about the direction of future WTO trade rules.

Safety Net Recommendations

The 21st Century Agriculture Policy Project has developed four recommendations concerning reforms to the income safety net for consideration in the upcoming Farm Bill.

- **Continue to provide economic stability through existing countercyclical programs.** To avoid painful economic dislocations, especially among smaller producers, the transition to more diversified and market-based sources of financial security must be a gradual one. The cornerstone of any farm policy must remain a robust income safety net. The core of the program must continue to include the two counter-cyclical elements of the current farm bill: a marketing loan program that treats all producers equally and the

[17] Robert Dismukes and Ron Durst, *Whole-Farm Approaches to a Safety Net,* USDA Economic Research Service, June 2006.

partially decoupled counter-cyclical program.[18] Aggregate annual payments to any producer under these programs should be capped at $250,000 per year.

- **Eliminate the direct payment program, which has artificially increased land values and thereby made it more difficult for a new generation to take up farming. Resulting savings, coupled with savings from reduced demand for counter-cyclical payments and LDPs, should be invested in developing new market opportunities for producers.** According to Bruce Babcock, eliminating direct payments will provide $5 billion in savings annually that could be used to benefit producers in other ways.[19] At the same time, growing demand for corn to supply biofuels plants is leading to higher corn, soybean, and wheat prices and reducing federal countercyclical payments and LDPs. If Congress enacts a more aggressive renewable fuel standard, savings associated with these lower outlays should average $4 billion per year over the next 25 years. The annual savings associated with all these changes—cutting direct payments and reducing countercyclical payments and LDPs—total $9 billion per year. New market opportunities should make it possible to naturally reduce reliance on traditional safety net programs while (a) simultaneously fulfilling resource commitments for existing programs that are widely supported but chronically underfunded, and (b) funding new initiatives (such as those described in these recommendations), and reducing the overall Farm Bill budget. The key to achieving this result will be to capture most of the savings that are expected to accrue as a result of eliminating the direct payment program, as well as high commodity prices and lower countercyclical and LDPs, and redirect those funds toward other conservation and renewable energy programs, if a case can be made for increased spending.
- **Help farmers to secure a larger equity-share in new, high-value agriculture-related enterprises.** As federal policy shifts to promote new economic opportunities for agricultural producers, it should also enable farmers and ranchers to gain a greater ownership stake in these value-added enterprises and thus capture a larger share of the wealth they generate. In the long run, this approach will provide a more robust source of financial stability for America's farm community while advancing energy security, conservation, and environmental objectives that are important to all Americans. Specifically, Congress should replace the current direct payment program with a Value-Added Equity Creation Program to provide farmers and ranchers with no-interest revolving loans so that they can participate in high-value agricultural-related business opportunities, such as biofuels plants and wind projects. Producers should be eligible to participate if their primary occupation is farming and

The cornerstone of any farm policy must remain a robust income safety net.

[18] Several groups have also proposed revenue insurance programs that would pay producers when revenues fall versus when price falls. Proponents of such systems say that this system would be more trade friendly. Given that it is unclear what will come from the WTO Round of talks, we believe that these proposals should continue to be studied and deserve to be considered for inclusion in the new farm bill on a limited pilot basis in addition to the current income safety net programs until future WTO trading rules are established.

[19] *Where to with Farm Policy? Lessons from the Past and Options for a Bio-Fueled Future,* by Bruce A. Babcock, Iowa State Univeristy, Prepared for the 21st Century Agriculture Policy Project, p. 35.

should be able to receive up to $100,000 in interest-free loans for equity investments in qualifying value-added enterprises (as certified by USDA). Qualifying enterprises would include businesses that add value to agricultural inputs by producing outputs such as ethanol, biodiesel, electrical power, lubricants, adhesives, pharmaceuticals, cosmetics, or building materials, etc., or business enterprises that improve the efficiency or environmental performance of processes used to produce agriculture commodities. The procedures used to certify qualifying enterprises could follow those used by the Treasury Department to implement the New Markets Tax Credit. In addition, certification should be limited to enterprises located in rural areas as defined in the 2002 Farm Bill.[20] Finally, entities with at least 50 percent investment from qualified agricultural producers should be eligible for federal loan guarantees on a portion of their outstanding debt. Such a program, if accompanied by a reduction in target prices equal to the current direct payment rates, would produce billions of dollars in savings each year that could be invested in expanded conservation programs and renewable energy and energy-efficiency projects designed to benefit farmers and ranchers.

- In recent years, Congress has frequently passed annual emergency spending bills to provide agricultural producers with disaster assistance. While these measures have provided important relief to farmers and ranchers, they have been ad hoc in nature and off-budget. As a result, Congress may decide to establish a permanent disaster assistance program to be administered by USDA to provide ranchers and farmers with assistance for clearly defined disaster conditions. If so, then we recommend that Congress replace the current system of ad hoc, off-budget emergency supplemental spending bills, make the permanent disaster assistance program on-budget as part of the Farm Bill, and include a reasonable benefit cap of $250,000 per farm or ranch in any single year. If a reasonable benefits cap is imposed, net federal outlays for disaster assistance should be reduced compared with the current off-budget approach.

[20] That is, an area other than (a) a city or town with more than 50,000 inhabitants or (b) the urbanized area contiguous and adjacent to such a city or town.

III. NEW MARKETS *for American Agriculture*

While U.S. agricultural policy *has traditionally focused on the production of food and fiber, the last two decades have seen growing recognition of the importance of the farm sector's role in providing other kinds of goods and services—notably with respect to* **energy production and land conservation and habitat preservation.**

Harvesting Energy

As both users and potential producers of energy, U.S. farmers are likely to be profoundly affected by ongoing developments in energy and climate policy; indeed, energy security and climate change concerns are quickly emerging as drivers for some of the most promising new market opportunities for modern agriculture. Policies to reduce greenhouse gas emissions are likely to create new costs while also providing new market opportunities related to reducing agricultural emissions and sequestering carbon.

Farm operations consume large quantities of diesel fuel, gasoline, natural gas, liquid petroleum gas, and electricity, as well as energy-intensive inputs like fertilizers and pesticides. In total, agriculture accounts for roughly 1.7 percent of overall U.S. energy consumption and a higher share (6 percent) of diesel and distillate fuel consumption. Natural gas, for example, accounts for as much as $306 of the approximately $326 cost of producing a ton of fertilizer.[21] Rising energy costs in general—and the potential for continued volatility and upward price pressures in oil and natural gas markets particularly—are therefore a significant concern for farmers and ranchers.

Interest in assisting the agriculture sector to both conserve more energy and produce more energy led Congress to include an energy title, for the first time, in the Farm Bill of 2002 (see text box on page 28). That title authorized a number of programs

[21] Agriculture as a Producer and Consumer of Energy. Edited by J. Outlaw, K.J. Collins, and J.A. Duffield. CABI Publishing. 2005.

to develop farm-based energy projects, but only four of the nine programs authorized were subsequently funded in the appropriations process. Meanwhile, one of the most agriculturally significant policies to be adopted in recent years was the renewable fuels standard (RFS) established as part of the 2005 Energy Policy Act. This policy requires fuel suppliers to meet a growing percentage of the nation's overall demand for gasoline using renewable fuels. The requirement translates to roughly 4 billion gallons of renewable fuel in 2006 and grows to an estimated 7.5 billion gallons in 2012. Besides the RFS, the 2005 Energy Policy Act included a number of additional programs specifically aimed at accelerating the commercialization of ethanol production using cellulosic (woody or fibrous) biomass feedstocks. Agriculture-relevant provisions of the Energy Policy Act are summarized along with the energy-related provisions of the 2002 Farm Bill on pages 28-29.

What Climate Change Will Mean for Agricultural Producers

Relative to other sectors of the economy, agriculture is among those most vulnerable to adverse effects from climate change, both to the extent that policies aimed at reducing greenhouse gas emissions could affect future energy prices and to the extent that changing climatic conditions will have a direct impact on growing conditions and water availability around the country. Though certain aspects of climate change (such as longer growing seasons) could produce some near-term benefits in some parts of the country, the available scientific evidence suggests that the net effect of warming on agricultural productivity in the United States is likely to turn overwhelmingly negative once a certain threshold of temperature change has been crossed. Climate impacts that are likely to be especially relevant for agriculture include warmer weather (with both higher average and peak temperatures), changes in precipitation with resulting impacts on soil moisture and water supply, changes in the frequency and intensity of extreme weather events, and effects on pests and pest vectors. Temperature and water stresses can impact livestock as well. Finally, predicted reductions in mountain snowpack and spring water runoff are likely to produce additional water stresses in western areas of the country, where disagreements over access to water are already fairly common.

Although the agricultural sector has proven to be adaptable, its greatest vulnerability to climate change may lie in the increased likelihood of extreme weather events such as floods, droughts, storms, and heat waves, and in the potential for indirect effects such as increased atmospheric ozone levels, which are damaging to crops. These and other potentially significant impacts on the agricultural sector have not been incorporated into most studies that have assessed how U.S. agriculture may fare under global warming. Additionally, most studies assume a stabilization of the climate system in the future, rather than continued increases in atmospheric concentrations of greenhouse gases. Unless stabilization is achieved, the rate and variability of climate change may compromise the ability of the agricultural sector to continuously adapt.

Relative to other sectors of the economy, agriculture is among those most vulnerable to adverse effects from climate change…

As a consequence, adaptation may actually prove to be more costly for the agricultural sector than has been predicted, or in some geographic areas may even be infeasible. During the European heat wave of 2003, the effects of heat, drought, and fires caused $15 billion in losses to the farming, forestry and livestock sectors. At the same time, most observers acknowledge that agriculture can play a significant role in reducing emissions of greenhouse gases by providing renewable feedstocks for biofuels and electricity production. Renewable energy markets, which are expected to grow substantially in the future in response to efforts to limit emissions of greenhouse gases, will offer new sources of income for farmers.

ENERGY PROVISIONS IN THE 2002 FARM BILL

Section 9002—Federal Procurement of Biobased Products
Requires federal agencies to give preference when purchasing items to those items that contain the highest percentage of biobased products whenever practicable and available, consistent with maintaining a satisfactory competition level, and when the purchase price exceeds $10,000.

Section 9003—Biorefinery Development Grants (Never Funded)
Provides for grants to individuals, corporations, farm cooperatives, farmers' associations, national laboratories, or institutions of higher education for the development and construction of biorefineries to demonstrate the commercial viability of one or more processes for converting biomass to fuels or chemicals. The grant amount is limited to 30 percent of project cost.

Section 9004—Biodiesel Fuel Education Program (Never Funded)
Provides for competitive grants to nonprofit organizations or institutions of higher education to educate governmental and private entities that operate vehicle fleets, other interested entities, and the public about the benefits of using biodiesel fuel. USDA is authorized to use up to $1 million annually in funds from the Commodity Credit Corporation for this program.

Section 9005—Energy Audit and Renewable Energy Development Program (Never Funded)
Provides for competitive grants to eligible entities (e.g., state energy or agricultural office; regional, state, or tribal energy organization; land-grant college or university; rural electric cooperative or utility; or nonprofit organization) to assist farmers, ranchers, and rural small businesses in becoming more energy-efficient and using renewable energy. Recipients of energy audits supported by this program must pay at least 25 percent of the cost of the audit.

Section 9006—Renewable Energy Systems and Energy Efficiency Improvements Program
Provides for grants and loan guarantees to ranchers, farmers and rural small businesses for renewable energy systems and energy efficiency improvements. Direct loans are authorized by legislation but have not yet been implemented. The minimum grant size is $2,500 and the maximum is $250,000 for energy efficiency improvements and $500,000 for renewable energy systems. Grants are limited to 25 percent of project costs. Demand for this program far exceeds available funding, with grants running at roughly one-third the level of applications.

Section 9007—Hydrogen and Fuel Cell Technologies (Never Funded)
Authorizes USDA to cooperate with the Department of Energy to promote hydrogen and fuel cell technologies in agricultural applications.

Section 9008—Biomass Research and Development
Extends the Biomass Research and Development Act of 2000 through September 30, 2007 at a funding level of $5 million in 2002 and $14 million per year for 2003 through 2007, to be made available from the Commodity Credit Corporation. An additional $49 million per year is authorized, subject to annual appropriations. The program awards grants to universities and private corporations for applied research and development projects covering any aspect of the conversion and utilization of biomass feedstocks to produce energy and chemicals.

Section 9009—Cooperative Research and Extension Projects (Never Funded)
Provides for USDA to cooperate with participants in the U.S. Global Change Research Program and with other eligible entities, including colleges and universities, to conduct research on carbon fluxes in soils and plants (including trees) and greenhouse gas exchanges with the atmosphere from other agricultural sources. Funding can be used for extension projects that demonstrate measurement tools and modeling techniques to monitor carbon fluxes and sequestration.

Section 9010—Continuation of Bioenergy Program
Authorizes continuation of the Commodity Credit Corporation's payment support program for ethanol and biodiesel production from corn, wheat, and other agricultural commodities; from cellulosic biomass (such as hybrid poplars and switchgrass); and from fats, oils, greases, and certain animal byproducts. Up to $150 million of funding from the Commodity Credit Corporation is made available for each year from 2003 to 2006.

Section 9011—Sungrant Initiative
Authorizes biomass research and development effort by leading land-grant institutions on a regional basis around the nation. Funded by the most recent highway legislation.

AGRICULTURE-RELEVANT PROVISIONS OF THE 2005 ENERGY POLICY ACT

Section 1501—National Renewable Fuels Standard
See discussion in main text.

Section 942—Production Incentives
Directs the U.S. Department of Energy (DOE) to provide incentives for the first 1 billion gallons-per-year of cellulosic biofuels production. Funds are allocated for proposed projects through set payments on a per gallon basis for the first 100 million gallons of annual production, followed by a reverse auction competitive solicitation process. In the latter process, incentives are awarded to the lowest bidders, with not more than 25 percent of funds available through the auction to be awarded to any single bid. The first auction would take place within one year after annual production reaches 100 million gallons of cellulosic biofuels, with subsequent auctions each year thereafter until annual production reaches 1 billion gallons. Total authorization is $250 million.

Section 1511(b)—New Cellulosic and Municipal Solid Waste Loan Guarantee Program
Authorizes "such sums as may be necessary" for new DOE program to provide loan guarantees for facilities that convert municipal solid waste and cellulosic biomass into ethanol and other commercial byproducts.

Section 1511(d)—Research Grants in RFG States
Authorizes EPA to provide research grants for renewable fuels production in RFG states ($25 million per year for 2006–2010).

Section 1511(e)—Cellulosic Biomass Ethanol Grants in Reformulated Gasoline (RFG) States
Authorizes DOE to provide grants to merchant producers for the construction of cellulosic ethanol plants in RFG states ($250 million in 2006, $400 million in 2007).

Section 1512—Cellulosic Biomass Ethanol Grants
Authorizes DOE to provide grants to merchant producers for the construction of cellulosic ethanol plants ($250 million in 2006, $400 million in 2007, $400 million in 2008).

Section 1516—Sugar-Derived Ethanol Loan Guarantees
Authorizes DOE to provide loan guarantees to carry out commercial demonstration projects for ethanol derived from sugarcane, bagasse, and other sugarcane by-products.

The Agricultural Producer as Conservationist

The Conservation Reserve Program (CRP) was created under the 1985 Farm Bill to encourage farmers to take highly erodible and otherwise environmentally vulnerable cropland out of production. Subsequent Farm Bills introduced similar programs to promote the conservation of sensitive wetlands and grasslands. These "set-aside" programs, which typically provide rent payments for land that is withdrawn from production and managed in an environmentally sustainable manner, are generally oversubscribed and underfunded even though they are popular with farmers and have been found to provide significant economic and environmental benefits. CRP-related improvements in wildlife habitat and water quality lead to billions of dollars of additional expenditures on outdoor recreational opportunities each year and provide a significant economic stimulus to rural communities. Moreover, set-aside programs limit the amount of acreage under cultivation, reducing cumulative annual yields and buoy commodity prices. Importantly, programs such as the CRP that are primarily motivated by environmental protection or habitat preservation rationales are generally exempt from challenge under international trade rules, though like other government-supported programs they remain susceptible to larger budget pressures. However, according to a 2006 study conducted by the Agriculture Policy Analysis Center (APAC) of the University of Tennessee, continuing CRP as is would produce a net savings of $6.3 billion in farm program payments over the 2007–2015 period studied.

The benefits of CRP to wildlife habitat (which are closely tied to the program's recreational benefits) are well documented. CRP is credited with providing habitat for an additional 12.4 million ducks in the northern Great Plains states between 1992 and 1997 (Reynolds et al. 2001). Nielson et al. (2006) estimated that CRP was responsible for a 22 percent increase in the counts of ring-necked pheasants for every 4 percent increase in CRP lands enrolled. Likewise, studies examining the population response of bobwhite quail

EXISTING FARM BILL SET ASIDE CONSERVATION PROGRAMS

THE CONSERVATION RESERVE PROGRAM (CRP)

Since it was first authorized in 1985, the CRP program has become one of the most important conservation programs in the country. It is the single most important program in existence for protecting wildlife habitat on a landscape scale and has produced documented benefits in terms of increased populations of waterfowl, grassland birds, pheasants, and prairie grouse. Population gains for game species such as elk, mule deer, white-tailed deer and pronghorn have also been reported on CRP lands. The program is designed to encourage farmers to convert highly erodible or environmentally sensitive cropland to permanent vegetative cover. Conservation practices implemented on CRP lands include establishing permanent grass and vegetative cover, planting trees, creating permanent wildlife habitat, building erosion control structures, providing filter strips and riparian buffers, and restoring wetlands. CRP payments have helped farmers plant millions of acres of grass and trees, reducing soil erosion and improving soil and water quality. As noted in the main text, resulting benefits for wildlife habitat have generated additional economic returns related to hunting, fishing, and other forms of outdoor recreation.

THE WETLANDS RESERVE PROGRAM (WRP)

Like the CRP, the Wetlands Reserve Program (WRP) is popular with farmers and provides a number of important public benefits, including improved habitat for migratory birds and wetland-dependent wildlife, enhanced water quality, flood control, and groundwater recharging. Since its inception, over 1.5 million acres have been enrolled in this program, which continues to generate more demand than it can support; the program currently has a national backlog of 2,900 applications for over 407,000 acres.

THE GRASSLAND RESERVE PROGRAM (GRP)

The Grassland Reserve Program (GRP) helps landowners and operators restore and protect grassland, including rangeland, pastureland, shrubland, and certain other lands, while maintaining these areas as grazing lands. The program emphasizes support for working grazing operations; enhancement of plant and animal biodiversity; and protection of grassland and land containing shrubs and forbs under threat of conversion to cropping, urban development, and other activities that threaten grassland resources. As with the USDA's other conservation programs, demand exceeds funding and applications for millions of acres have gone unfunded.

(Riffell and Burger 2006) and greater sage grouse (Schroeder et al. 2006) to CRP showed positive relationships as well.

Fostering New Market Opportunities for Agricultural Producers

Against the backdrop of challenges outlined in the previous chapter, farmers and ranchers can continue to contribute multiple, high-value goods and services in markets that play to America's strengths in technology, science, and innovation. A wide array of agricultural outputs can be included in this category—from organic meat and produce and other specialty foods to biotech-derived drugs, vitamins, and other chemicals—but this project has focused on four specific areas of opportunity: biofuels, renewable electricity generation and other on-farm renewable energy projects, carbon sequestration, and land conservation/outdoor recreation. Each is discussed in detail in this section.

First, however, it is important to emphasize a more general point about the importance of farmers gaining a larger equity stake in the value-added enterprises that will emerge to supply these new markets. Owning a share of future wind farms or biorefineries, rather than simply receiving lease payments for hosting turbines or supplying feedstocks to ethanol production plants, is critical if agricultural producers are to maximize their income gains from new value-added markets, and thereby improve their long-term financial security. Farmers understand the benefits of ownership as illustrated by their increasing interest in investing in biofuels enterprises. At the same time, however, investment requirements for ethanol plants, in particular, are also rising: minimum requirements for many new plants start at $25,000 and some industry experts see the typical threshold level increasing to $100,000. Meanwhile, although some work has been done to make the purchase of renewable energy

systems and energy efficiency improvements more affordable for farmers, there has been no comprehensive effort to help farmers across the country secure a greater ownership stake in the rapidly emerging bioenergy marketplace. Robust policies to help farmers gain and retain equity in value-added agricultural enterprises could provide multiple important benefits, including (1) promoting investment in new, value-added uses for agricultural products, (2) diversifying the rural economy, (3) rewarding farmers and ranchers for environmentally sustainable agricultural products and practices, and (4) reducing the need for commodity payments.

A. Biofuels

As noted in the foregoing chapter, ethanol from corn is already the most prominent example of how American agriculture can help to meet the nation's energy, as well as food and fiber, needs. Domestic ethanol production capacity—which currently includes some 113 plants in 19 states—is over 5.5 billion gallons per year and expanding rapidly. Nearly all of the ethanol produced in the United States at present is made from corn and sorghum, though smaller amounts are also being made from cheese whey, beer, and beverage waste. Ethanol production currently consumes less than 20 percent of the U.S. corn crop. The current RFS mandate reaches 7.5 billion gallons by 2012 (enough to supply about 6 percent of the energy requirements of the nation's light-duty vehicle fleet), with the potential for a larger renewable-fuels contribution after 2012. EPA estimates that achieving domestic production capacity of 7.5 billion gallons per year—which will probably be reached by 2008—will reduce U.S. oil consumption by 88,000 barrels of oil per day.

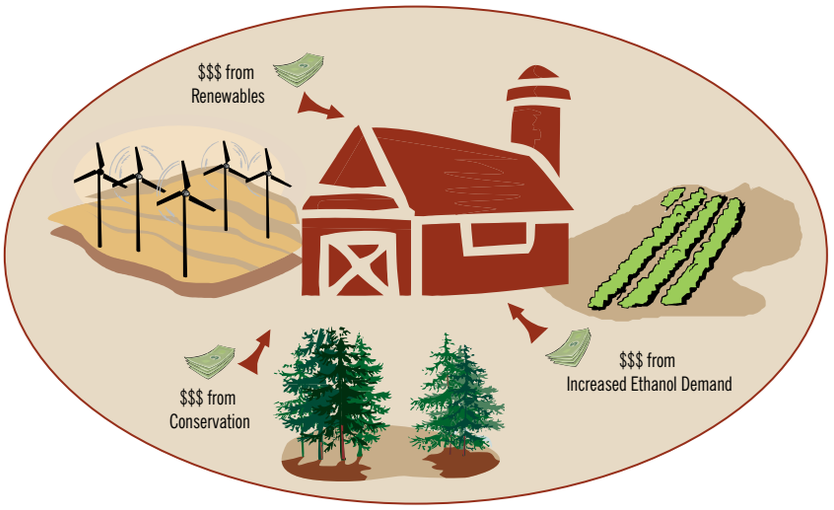
Many policymakers and energy and environmental advocates see the current ethanol boom as only a beginning. For example, a coalition of farmers, governors, and others are proposing that America adopt the target of meeting fully 25 percent of its total energy needs with renewable farm-based projects by 2025. The coalition has dubbed itself "25X25." Similarly, the goal of the Bush Administration's Advanced Energy Initiative is to achieve an ethanol production level of 60 billion gallons per year, which it claims can be accomplished without compromising the nation's ability to meet its food and feed needs. Finally, President Bush in his January 2007 State of the Union speech proposed establishing an alternative fuels standard of 35 billion gallons per year by 2017, although this standard could be met with non-biomass-based fuels, such as coal-to-liquids.

Any expansion of biomass-based fuel production on these scales has the potential to dramatically reshape American agriculture and American farm policy in the decades ahead. As noted above, ethanol demand is already generating significant returns for some producers and putting upward pressure on corn prices. The industry's continued expansion will likely result in higher prices not only for corn, but also for soybeans and wheat (as acreage now in these crops is shifted to grow corn).

…ethanol from corn is already the most prominent example of how American agriculture can help to meet the nation's energy, as well as food and fiber, needs.

At the same time, it should be recognized that the rise of corn prices associated with biofuels production can create hardship for other agricultural producers, consumers and other stakeholders. Recently, corn futures prices have exceeded $4.00 per bushel, leading livestock and poultry producers to complain about negative impacts on their profitability. However, these

Income Opportunities for the 21st Century Farm



The technology needed to convert cellulose to ethanol exists today and is making the transition from demonstration-scale plants to commercial-scale plants.

high prices also have caused producers to declare their intention to plant over 90 million acres of corn in 2007; this has resulted in corn futures prices dropping back to about $3.50 per bushel. Consumers are also expected to see modest increases in food prices as corn prices rise. In addition, conservation organizations are concerned that high corn prices will lead many farmers to plant corn on marginal lands that are currently enrolled in CRP, once those enrollment contracts expire. Fearing a loss of habitat benefits, these same organizations have expressed opposition to the use of CRP lands for growing and harvesting cellulosic feedstocks like switchgrass. As a result, it has been pointed out that the potential to displace imported oil from corn ethanol therefore is limited.[22]

The Transition to Cellulosic Ethanol

Since corn faces competing demands for food and animal feed, and has become more expensive, any large-scale shift towards biofuels will necessarily involve a larger array of biomass feedstocks like cellulosic materials. Corn faces competing demand for food and animal feed; it is, moreover, a relatively expensive and energy-intensive feedstock compared with cellulosic alternatives, due to the fertilizer and other inputs required to grow it. Accordingly, many experts conclude that expanding the domestic ethanol industry beyond 15 billion gallons per year will require the use of other feedstocks and, in particular, the commercialization of competitive technologies for producing ethanol from cellulosic (woody or fibrous) plant material. Because cellulosic ethanol would open the door to potentially more plentiful and less expensive feedstocks, it has long been regarded as the key to a greatly expanded role for biomass-based fuels and is the focus of significant private and public research efforts. Indeed, most of the new biofuels programs authorized under the Energy Policy Act of 2005 and summarized in the text box on page 28 are targeted to cellulosic ethanol. Private investors are also placing bets on cellulosic ethanol: the venture capitalist Vinod Khosla, for example, has argued that with reasonable breakthroughs in the genetic engineering of cellulosic feedstock crops, the United States could produce 150 billion gallons per year of ethanol—enough to meet most of its current light-duty transportation fuel needs. Other breakthroughs in genetic engineering are likely to lead to the development of new types of biofuels, such as biobutanol, that have higher energy densities and lower blending vapor pressures.

The technology needed to convert cellulose to ethanol exists today and is making the transition from demonstration-scale plants to commercial-scale plants. Due to the new nature of the technology, most observers agree that this transition will require the federal government to assume some of the financing risk. As a result, eight separate programs designed to promote alternatives to corn ethanol, primarily focused on providing loan guarantees, are scattered through three federal agencies (EPA, DOE, and USDA). To successfully implement these programs, the federal government will need to appropriate new funds each year through its annual budget process and effectively

[22] Tillman and Hill, "Corn Can't Solve Our Problem," Washington Post, Page B01, March 25, 2007.

coordinate efforts across agencies—a tall order, to be sure, but one with large potential payoffs in terms of accelerating the development of a mature cellulosic ethanol industry and reducing the nation's dependence on oil. If the United States is indeed serious about substantially expanding biofuels production for domestic economic and energy security reasons, then more rational and better financed programs are merited. In particular, Congress may want to consider (1) consolidating these programs at a single agency, such as USDA, which has considerable experience in administering loan guarantees, and (2) providing a secure and reliable funding mechanism, such as an energy security trust fund, to ensure that loan guarantees for innovative cellulosic ethanol plants can be granted on a consistent and predictable basis.

Current State of the Cellulosic Ethanol Industry

Development of commercial-scale cellulosic ethanol plants is expected to occur within the next two to three years in the United States. Cellulose, a complex carbohydrate with hundreds of long molecular chains bound to each other, is present in many agricultural materials. Potential cellulosic feedstocks include corn stover, wheat and rice straw, dedicated energy crops, wood and wood residues, among others. The cellulosic production process relies on two basic conversion pathways: enzymatic breakdown and gasification. Currently, the enzymatic processes appear closer to commercial-scale development than those based on gasification (see text box below).[23]

- **Xethanol Corporation** of New York has announced plans to build a 50 million gallon-per-year cellulosic

ENZYMATIC BREAKDOWN VERSUS GASIFICATION

Enzymatic Breakdown: Converting cellulosic material to ethanol using enzymes involves a two-step process: first breaking the long chains of cellulose molecules into glucose and other sugars and second fermenting these sugars into ethanol. Each step as it occurs in nature is performed by different organisms: fungi and bacteria that use enzymes to free the sugar in cellulose; and other organisms, like yeasts, that ferment the sugars into ethanol. Thus far the main challenge in producing cellulosic ethanol has been to improve the biological efficiency and reduce the cost of breaking down cellulose into sugars. The ideal organisms would do it all: break down cellulose like a bacterium, ferment sugar like yeast, tolerate high concentrations of ethanol, and dedicate most of its metabolic resources to produce just ethanol. Significant progress has been made in improving this process recently. In October of 2004, two firms working independently but both with support from the National Renewable Energy Laboratory (NREL) developed a genetically modified organism that produces large amounts of cellulose enzymes capable of digesting cellulose efficiently. These companies were *Novozymes*, a Denmark-based company, and *Genecor*, a firm based in California. This development marked a milestone because it reduced the cost of enzymatic digestion from 5 dollars per gallon of cellulosic ethanol in 2001 to 10–18 cents per gallon of ethanol; reducing the gap between the total cost of cellulosic ethanol and that of corn grain ethanol to 50 cents per gallon, given comparable feedstock costs. *Abengoa Bioenergy,* an ethanol producer based in Spain, will test *Novozymes's* process at a 0.53 million gallon capacity pilot plant in York, Nebraska. Meanwhile, a collaborative effort between Dartmouth University and University Stellenbosch in South Africa, led by Dartmouth professor Lee Lynd, a cellulosic ethanol expert, has reported significant progress in developing a yeast that can survive on cellulose alone, breaking down the complex molecules and fermenting the resultant glucose into ethanol.

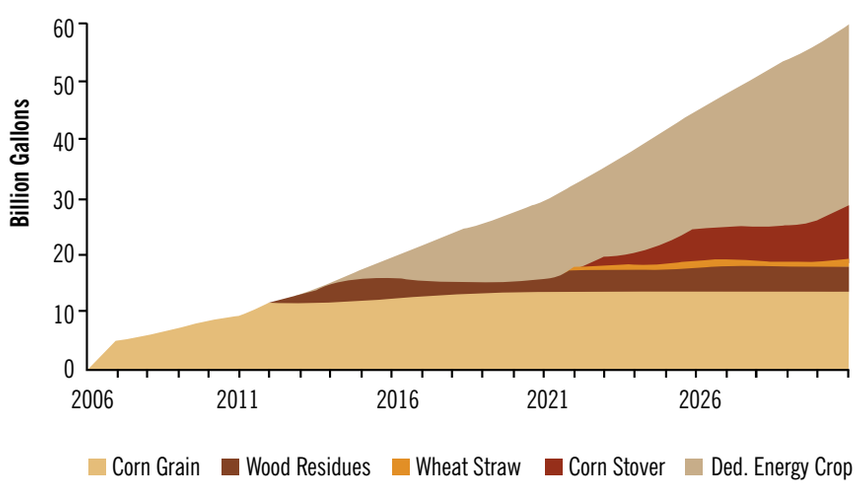
Gasification: A second cellulosic ethanol production pathway that is being pursued involves the gasification of biomass through a thermochemical process. Through gasification the feedstock is subject to very high temperatures and converted into a synthetic gas. The feed gas is then converted into liquid fuels using the *Fischer-Tropsch* (FT) process, which was first developed in Germany in the 1920's and used during World War II. The process was later commercialized by *Sasol* in South Africa as a means of producing oil and gasoline from coal, referred to as coal to liquids (CTL), in response to apartheid-era boycotts. FT fuels are still being produced in South Africa. *Exxon, Rentech, Sasol* and *Shell* offer commercial processes. FT fuels can be produced from biomass feedstocks such as corn stover (corn stalks), wood or switch grass.

[23] From De La Torre Ugarte et al. 2006.

ethanol plant in Augusta, Georgia. *Xethanol* will partner with *PRAJ Technology,* an India-based world leader in bio-ethanol technology. The proposed plant will be designed to process multiple cellulosic feedstocks; however it will start by processing residues from forestry operations.

- **BlueFire Ethanol,** a California-based company has announced its intentions to build 20 cellulosic ethanol plants in the next six years, with total production capacity of 1.5 billion gallons per year. For this purpose it has signed a memorandum of understanding with *MECS, Inc.* as its lead engineering and procurement contractor. *BlueFire Ethanol* intends to deploy the *Arkenol* process for the conversion of wood residues, urban-waste, and agricultural residues into ethanol.
- **DuPont** and **Chevron** have each announced joint ventures to advance the conversion of cellulosic ethanol into biofuels. *DuPont* and ethanol producer *Broin* plan to produce biofuels from corn stover by converting one of Broin's six corn-to-ethanol plants in Iowa into a biorefinery that will use both corn grain and corn stover. *Chevron* and the National Renewable Energy Laboratory (NREL) have signed a five-year research and development agreement to explore new production technologies for converting biomass, such as forestry and agricultural waste, into ethanol.

FIGURE III.A: ETHANOL QUANTITIES FROM SELECTED FEEDSTOCK UNDER THE ETH60 SCENARIO



Source: De La Torre Ugarte et al. 2006

- **Iogen Corporation** of Ottawa, Canada is teaming up with *Royal Dutch Shell* and *Goldman Sachs* to expand its cellulosic pilot plant in Ottawa into a larger commercial operation. Based on experience with this pilot facility, Iogen expects that a larger, commercial–scale plant will be capable of producing cellulosic ethanol at a starting price of $1.35 a gallon. That would be competitive with current gasoline prices, although it is still more expensive than ethanol from a modern corn-ethanol plant, which the Energy Department estimates costs about $1 per gallon to produce.
- **SunOpta Inc.**, a Toronto-based company, has sold a continuous process system for the conversion of biomass-to-ethanol to Massachusetts-based *Celunol Corp (formerly BC International).* The patented pretreatment and hydrolysis technology will prep and convert sugar cane bagasse and possibly hardwood waste to ethanol at a plant in Jennings, Louisiana. *Celunol/BC International* has been conducting research and development in Jennings with a small-scale pilot cellulose conversion system at an existing facility where much of the necessary infrastructure is already in place.

Continued progress in genetic engineering, the development of specialized enzymes, gasification processes, and advanced "bio-refinery" systems that would allow for efficient co-production of multiple high-value fuels and chemicals could transform prospects for the biofuels industry. Additionally, commercialization of small-scale, farmer-owned bio-refineries would enable farmers to generate renewable energy for on-farm and off-farm needs, while investing in their own long-term sustainability.

How Far Can We Go With Biofuels?

As part of this project, researchers at the University of Tennessee evaluated a bipartisan proposal introduced in the U.S. Senate to create a renewable fuel standard of 10 billion gallons per year by 2010, 30 billion gallons per year by 2020, and 60 billion gallons per year by 2030. Figure III.A shows the mix of feedstocks that could be used to reach 60 billion gallons per year of biofuels production in the United States (De La Torre Ugarte et al. 2006).

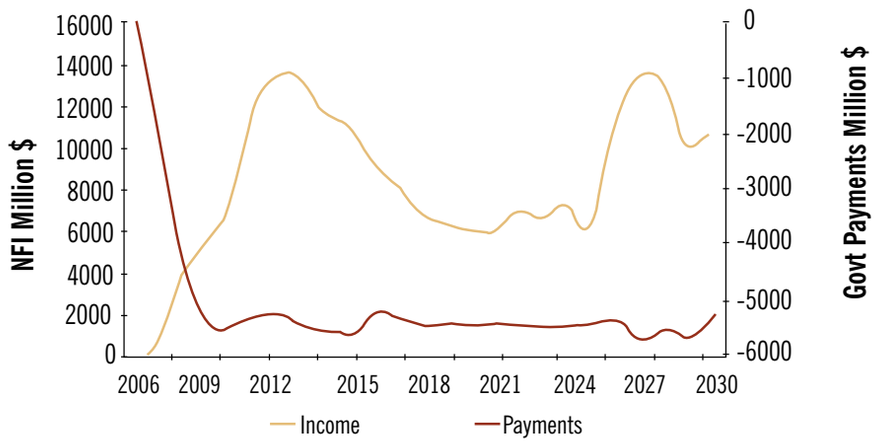
As noted previously, the growing biofuels industry will cause prices for corn, soybeans, and wheat to rise, dramatically reducing government outlays for

countercyclical and loan deficiency payments and sharply increasing net farm income, as shown in figure III.B (De La Torre Ugarte et al. 2006).

The study by University of Tennessee researchers commissioned for this report made a number of impressive findings:

- The United States can meet its food and feed demands and produce 60 billion gallons of renewable fuel per year, enough to displace over 20 percent of the nation's gasoline consumption;
- Roughly 1.6 billion gallons of biodiesel would be produced from soybeans and waste grease annually;
- Between 2007 and 2030, roughly $368 billion in additional economic activity and 2.4 million jobs would be created;
- Between 2007 and 2030, net farm income would increase by a total of $210 billion, while federal farm payment outlays would decline by as much as $150 billion;
- Due to the widespread geographic distribution of biofuel feedstocks, economic gains would accrue to most parts of the country, with the Midwest producing cellulosic ethanol primarily from agricultural residues, the South and Southeast producing considerable quantities of ethanol from dedicated crops, and the West, Southeast, and Northeast producing ethanol primarily from wood waste.
- Savings associated with lower federal Farm Program payments likely would exceed $100 billion over the 25 year period;
- The biofuels industry would generate $45 billion in additional federal and state tax revenue;
- The target production level of 60 billion gallon per year does not represent an upper limit to potential energy production from the agricultural sector, although exceeding this goal could require such steps as increasing the efficiency of cellulose conversion and allowing lands enrolled in the Conservation Reserve Program (CRP) to be used for feedstock production.

FIGURE III.B: CHANGES IN NET FARM INCOME AND GOVERNMENT PAYMENTS UNDER THE ETH60 SCENARIO



Source: De La Torre Ugarte et al. 2006

Potential Use of the Conservation Reserve Program (CRP) Lands for Feedstock Production

There has been considerable debate about whether the large-scale cultivation and harvesting of biomass for energy purposes can be managed in ways that complement conservation objectives—and in particular whether it is appropriate to allow CRP lands to be used for producing cellulosic biofuel feedstocks like switchgrass. In fact, the 2002 Farm Bill included provisions to allow just that. Wildlife organizations, however, have generally opposed this approach, arguing that it could compromise other important CRP goals such as reducing erosion, improving water quality, and providing wildlife habitat. Moreover, using the CRP program to support biofuels production raises a number of practical difficulties. Currently, USDA uses an Environmental Benefits Index (EBI) to score CRP applications and enroll those lands that, by participating in the program, stand to provide the most environmental benefit. For biofuel feedstocks, by contrast, proximity to fuel production and processing facilities is the primary factor to be considered in choosing optimal sites. Since CRP enrollment required competitive bids and is scored using the EBI, there may be little overlap between CRP lands and lands that are sufficiently close to a production facility to be economic for growing biofuels feedstocks. Perhaps most importantly, most CRP lands are considered "marginal" for crop production and may not be capable of producing desired yields, even when planted with hardy cellulosic feedstocks. A better approach, therefore, may be to promote the use of non-CRP lands for cellulosic feedstocks, in combination with cultivation practices that simultaneously maximize other environmental benefits and advance conservation objectives on those lands.

THE HALLBERG PRIME BIOSOLUTIONS PLANT: A CASE STUDY

A new facility being developed by the entrepreneur David Hallberg in Mead, Nebraska will combine corn-ethanol production with a livestock feedlot and an anaerobic digester. This new configuration of technologies will use virtually no fossil-fuel energy inputs and will provide numerous economic and environmental benefits. At the Prime Biosolutions plant, proteins generated as a by-product of the ethanol production process will be fed to cattle at an adjacent feedlot. The cattle manure will be collected and converted by an on-site anaerobic digester into fertilizer and methane. The methane, in turn, will power the ethanol plant. This system departs from conventional practice in that it eliminates the capital and energy-intensive drying equipment that is needed if the protein co-products are shipped to offsite beef or dairy animal feeding operations—instead the protein is fed directly to the ruminant animals on-site without drying. This feature alone reduces the energy required to produce a gallon of ethanol by approximately 50 percent. The digester produces sufficient biogas to eliminate the need for purchased natural gas and makes the system essentially "fossil-fuel free." The anaerobic digestion system also controls odors from the animal wastes, and produces natural fertilizers that not only displace fossil fuel-based fertilizers, but are highly sought after by local farmers to increase yields and improve soil quality. The first commercial-scale demonstration of this integrated new approach will involve an existing, specially-designed feedlot with 30,000 head of cattle. It is expected to reduce emissions of the three primary greenhouse gases (carbon dioxide (CO_2), methane (CH_4), and nitrous oxides (N_2O)) by more than 150,000 metric tons of CO_2 equivalent per year. Fossil fuel inputs will be approximately 95 percent lower than for a conventional ethanol plant, which relies heavily on natural gas to provide the thermal energy (steam) required for fermentation and distillation, and for the drying of protein by-products.

Promoting Energy Efficient Ethanol Production for a Low-Carbon World

As energy costs continue to increase and the U.S. adopts mandatory limits on greenhouse gases, producers of energy-efficient, low-carbon alternative fuels, like ethanol, and particularly cellulosic ethanol, will benefit. Hundreds of new biofuels plants are in the construction and/or planning stages currently and are expected to be operating in the next few years. To what extent these plants will benefit from the establishment of carbon limits will depend to a large extent on what energy source—coal, natural gas, or biomass—is used to fuel the feedstock-to-ethanol conversion process.

For ethanol producers, the expense of fossil fuel inputs is second only to the cost of organic feedstocks. As a result, the corn ethanol industry has made considerable strides in the last decade in reducing fossil fuel inputs. In the mid-1990s, it took 50,000 to 100,000 BTUs to make one gallon of ethanol. Ten years later, it took only 25,000 to 35,000 BTUs to make one gallon of ethanol, meaning that energy use was cut by more than half in many cases.[24] Similarly, ethanol plants today generate 2.8 gallons of ethanol from a single bushel of corn, compared with only 2 gallons a decade ago.

While a wide variety of energy systems and equipment configurations exist at ethanol plants, the two dominant energy sources are natural gas and coal. These are used primarily to cook the corn, distill and dehydrate the ethanol, and evaporate and de-water the distillers dried grains with solubles (DDGS). According to Ethanol Producers Magazine, 90 percent of surveyed ethanol plants in operation use natural gas as their major energy feedstock. Natural gas prices have been extraordinarily volatile during the past five years, steeply increasing production costs at times and causing some ethanol plant developers to consider other energy sources like coal.

It is likely that the United States will adopt a cap on greenhouse gas emissions at some point in the next several years, thereby creating markets that will financially reward low-carbon biofuels. Moreover, initiatives like California's new Low Carbon Fuel Standard, which will boost the state's use of biofuels from nearly 1 billion gallons per year at present to 3–5 billion

[24] Brian Jennings, Executive Vice President, American Coalition for Ethanol, presentation to the 21st Century Agriculture Policy Project, May, 2006.

gallons per year, will further encourage demand for biofuels produced from lower-energy and lower-carbon technologies and fuels.[25] Examples of such low-carbon feedstocks, processes and techniques include:

Biodiesel Feedstocks

- Soybeans
- Waste grease

Ethanol Feedstocks

- No-till corn
- Corn stover
- Wood waste
- Perennial grasses
- Bagasse
- Wheat straw
- Municipal solid waste

Biofuel Plant Energy Inputs

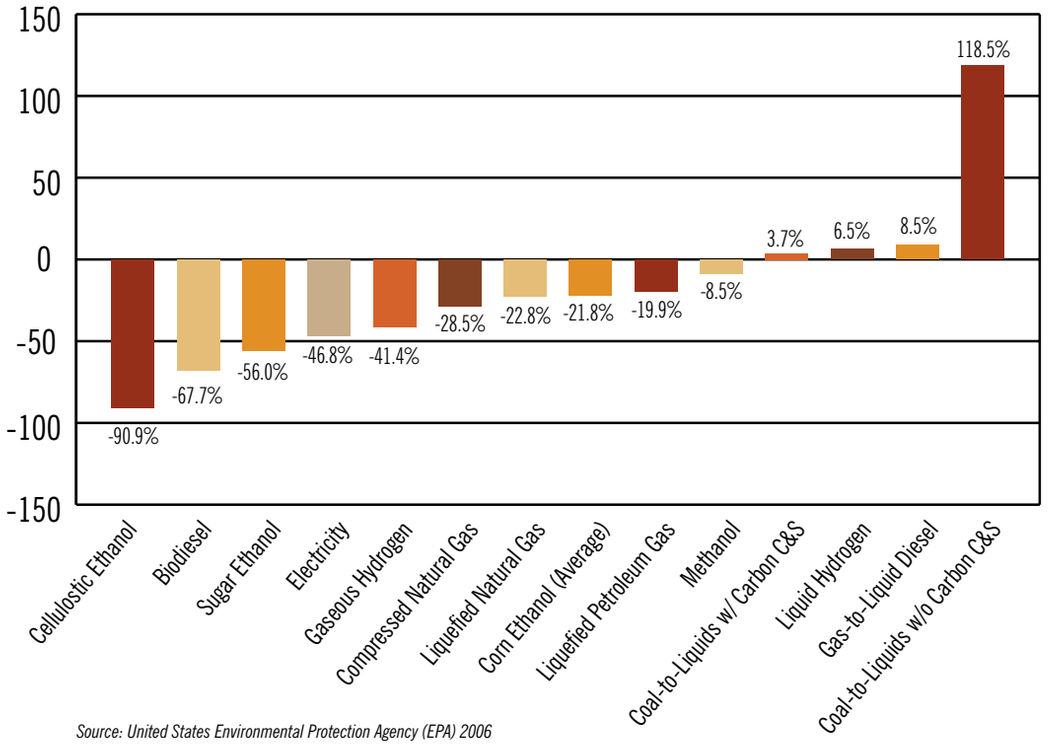
- Biomass-fired integrated gasification combined-cycle system using a biomass energy crop
- Co-firing biomass residue with coal
- Natural gas combined-cycle power plant
- Direct-fired biomass power plant using biomass residue
- Methane from anaerobic digestion of animal waste

Energy-saving Techniques

- Cold fermentation
- Co-location of livestock feedlots to eliminate the DDGS drying step

The feedstock and technology choices made by ethanol producers in the future will determine the extent to which they are economically competitive. Below is a chart developed by the U.S. Environmental Protection Agency demonstrating the various greenhouse gas emission characteristics associated with different forms of ethanol compared with conventional gasoline.[26]

FIGURE III.C: PERCENT CHANGE IN GHG EMISSIONS



Source: United States Environmental Protection Agency (EPA) 2006

[25] State of California, Office of the Governor. "The Role of a Low Carbon Fuel Standard in Reducing Greenhouse Gas Emissions and Protecting Our Economy." White Paper, 2007.

[26] From U.S. Environmental Protection Agency, Office of Transportation and Air Quality, April 2007. "Greenhouse Gas Impacts of Expanded Renewable and Alternative Fuels Use." EPA420-F-07-035.

Nebraska entrepreneur David Hallberg is developing a new, energy-efficient ethanol production facility that uses a methane digester in combination with a corn ethanol production plant and cattle feedlot to save energy (see text box page 36). Congress should recognize the inherent environmental and future economic value of encouraging the use of such processes and provide adequate incentives through the tax code and through grant, loan, and loan guarantee programs at USDA.

The Future of Ethanol Tax Incentives

The federal government has provided tax incentives for the use of renewable fuels since 1978. Incentives were established largely in reaction to the oil shocks of the 1970s, in hopes of promoting a domestic alternative fuel industry that would help mitigate the impacts of future oil supply shortages and price increases. Over the last three decades, these incentives, in combination with clean fuel regulations, have encouraged the growth and development of a modest-sized domestic ethanol industry. Today, ethanol blenders and producers have become familiar with using these incentives and have factored them into long-term contracts.

Currently, all ethanol sold in the United States benefits from a 51 cent per gallon blender tax credit, known as the volumetric ethanol excise tax credit (VEETC). This credit is set to expire in 2010. An offsetting tariff on imported ethanol of 54 cents per gallon exists to ensure that U.S. taxpayers do not subsidize imported ethanol. In addition, ethanol production facilities with production of up to 60 million gallons per year receive a 10 cent per gallon tax credit on the first 15 million gallons of production. The combination of tax credits, consistently higher world crude oil prices, and the elimination of MTBE from the fuel supply has led to explosive growth in the ethanol industry. According to Babcock (2006), if all the ethanol plants currently planned or under construction are built, U.S. ethanol production capacity will be 18 billion gallons per year by 2012. The rapid growth of the industry has led some to question whether it will be financially possible for the federal government, at a time of high annual budget deficits, to extend these ethanol tax incentives indefinitely at their current levels. Some observers have proposed restructuring the tax credit to rise and fall with the world price of oil. While this likely would reduce the cost of the tax credit, others have questioned whether it would be sufficient to support the growing industry at a time of rising feedstock costs.

The benefits of the domestic biofuels industry merit further federal support, including the extension of tax incentives and offsetting tariffs for ethanol sufficient to ensure market demand for biofuels and to allow ethanol plant developers to thoroughly amortize recent and future investments. Rapid growth of the biofuels industry is expected to lead to saturation

of the E-10 blend market by 2010 or 2011, which could result in a supply glut and market prices for ethanol that would be insufficient to sustain industry profitability. Therefore, in addition to extending the tax credits, work is needed to develop higher blend markets, such as E-20 and E-30, and to adopt new tax policies and other measures necessary to accelerate the growth of the E-85 market.

Biofuels Recommendations

To promote biomass-based alternative liquid fuels, Congress should:

- **Expand and extend the recently-adopted renewable fuels standard (RFS)** to reach at least 10 billion gallons per year by 2010, 30 billion gallons per year by 2020, and 60 billion gallons per year by 2030, as proposed in bipartisan legislation introduced in the U.S. Senate. This step would lead to expansion of biofuels markets beyond the E-10 market and spur new investment in the next generation of advanced biofuels technologies, such as cellulosic ethanol.
- **Promote the use of higher blends of ethanol** in the existing fleet of automobiles by instructing the Environmental Protection Agency to conduct analysis of the viability of using higher blends of ethanol (including E15, E20, E30, and E-40) in the existing fleet of automobiles by January 1, 2009.
- **Extend the existing VEETC to 2020 while simultaneously restructuring this program in ways that account for expected growth in corn ethanol production volumes under an expanded national RFS.** After the current tax incentive authorization expires in 2010, Congress should look for ways to ensure that the cost of the tax credit—in the context of other policies and expected ethanol production volumes—remains acceptable, while ensuring that new and innovative biofuels project are provided the support they need to be successful. Among the criteria that Congress should use to design the post-2010 biofuels tax credits are:
  1. Limiting the overall cost of the tax incentives to the government;
  2. Encouraging expansion of the industry by ensuring that investments in new plants and recently-built plants can be fully amortized;
  3. Rewarding energy-efficient and low-carbon emitting technologies;
  4. Ensuring that pioneering processes, such as those that convert cellulosic feedstocks like corn stover and switchgrass to ethanol, are economically competitive with fossil fuels;
  5. Encouraging farmer ownership of ethanol plants;
  6. Balancing domestic tax credits with an import duty of similar size, so that U.S. taxpayers do not subsidize ethanol imports to the detriment of American producers.

It is likely that the United States will adopt a cap on greenhouse gas emissions at some point in the next several years…

- **Extend the small producer renewable fuels tax credit beyond 2008 for plants that are at least 40 percent locally-owned and for cellulosic ethanol plants.**
- **Consolidate all cellulosic biofuels loan guarantee programs into a single program at USDA and establish an energy security trust fund to provide consistent funding for that program.** Successfully commercializing the production of ethanol and other fuels from cellulosic (i.e., woody or fibrous) plant materials would dramatically expand the potential contribution of biofuels in terms of displacing current petroleum use and associated carbon emissions. Implementing many existing loan guarantee programs through three separate federal agencies makes little sense. USDA has considerable experience in implementing loan guarantee programs and in evaluating biofuels projects through its Office of Energy. Therefore, Congress should consolidate all federal biofuels grant and loan guarantee programs at USDA and establish a national energy security trust fund to provide at least $1 billion per year in loan guarantees and grants to promote necessary advances in production technology and bio-science.
- **Establish a demonstration cellulosic biofuels feedstock program.** Congress should establish a new set-aside program to demonstrate how the cultivation and harvesting of cellulosic feedstocks could be accomplished in an economically attractive manner. Following the model of several existing programs, the 2007 Farm Bill should provide a modest payment to landowners who convert existing cropland to grow cellulosic biofuel feedstocks for nearby cellulosic

biofuels plants in ways that improve wildlife habitat, reduce soil erosion, and protect water quality. New lands to be set aside under such a program should be capped at 500,000 acres for the duration of the 2007 Farm Bill.

- **Establish policies to encourage a rapid increase in the number of flexible fuel vehicles sold in the United States and the installation of E-85 pumps and blender pumps at gasoline stations.** For example, we recommend extending the existing tax credit for installing E-85 refueling stations and redesigning it to provide relatively greater benefits in the near-term to encourage more rapid deployment of E-85 infrastructure. We also recommend clarifying that blender pumps be eligible for the tax credit, since in the long run it will make more sense to install blender pumps that are capable of dispensing a range of ethanol blended fuels. Congress also should consider more attractive expensing and accelerated depreciation options to encourage installation of E-85 and blender pumps in lieu of tax credits.

B. Renewable Electricity Production

Depending on their location, many rural areas have great potential to generate electricity from the wind, geothermal resources, biomass, and the sun. Moreover, developing this potential would be compatible, in many cases, with continued use of lands for existing farming and ranching purposes. Most of the time, this approach would also be preferable to—and far less controversial than—appropriating pristine or undeveloped areas for renewable energy production. Interest in developing renewable energy opportunities in the agricultural community is growing: John Deere, the world's largest maker of farm equipment, has established a new division to provide financing and project development support for farmers who want to develop wind projects on their lands. John Deere believes that installed wind capacity in the United States could grow by a factor of 15 in the next 15 years—from less than 7,000 MW today to over 100,000 MW in 2020. Much of this development could, and in our view should, occur on farmlands.

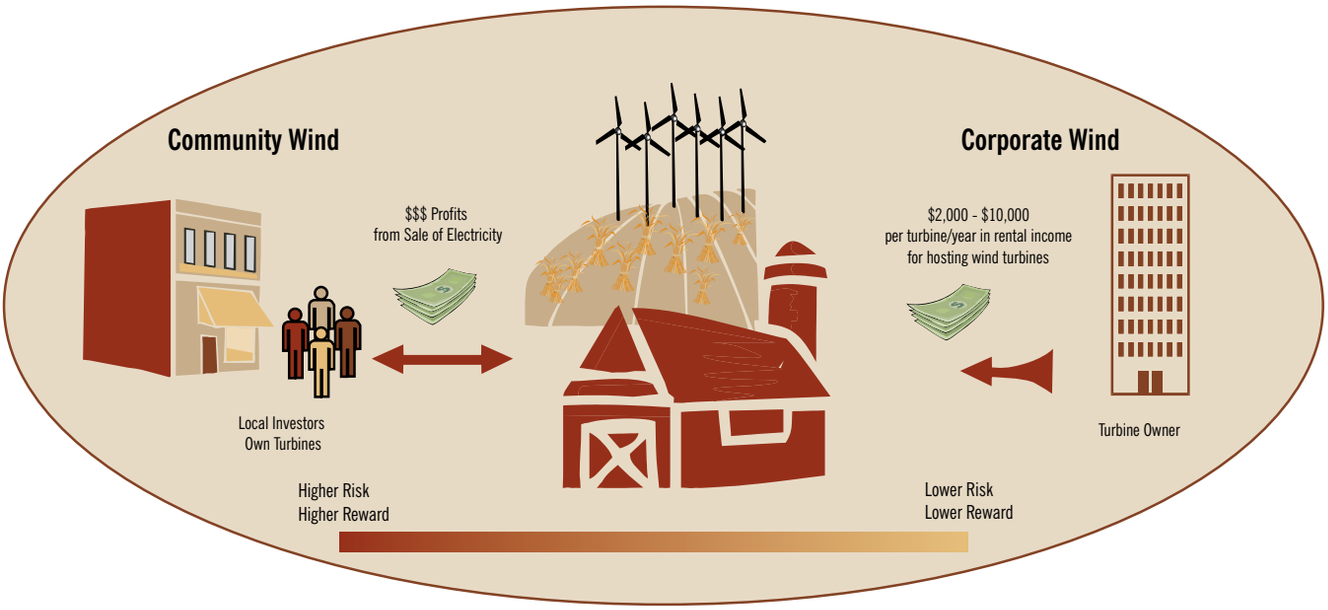
The states with the greatest wind potential in the country are located in the Great Plains: Montana, North Dakota, South Dakota, Minnesota, Wyoming, Nebraska, Iowa, Kansas, Colorado, Oklahoma, New Mexico, and Texas. Other states outside the Midwest, like Oregon and Washington, also have considerable wind resources. Not only do the Midwestern states have enormous wind potential, they are predominantly rural, with large farm populations. As such, future wind development in these areas represents a potential source of considerable income for hundreds of thousands of farmers, ranchers and other private landowners, as well as the wind energy development industry. However, the magnitude and duration of wind-related economic opportunity available to landowners will depend on a variety of market and regulatory factors.

Dairy and livestock operations can be significant producers of electricity and natural gas as well, through manure digesters. By using simple digesting techniques and equipment, farmers can process manure into methane (biogas), which can be cleaned up for use in pipelines, used to produce on-farm heat, or burned in generators to produce electricity. At the same time, this can resolve issues around odor and water effluent that increasingly bring livestock operations into conflict with neighbors and environmental regulators. Dairy operations in Wisconsin, California, and the Northeast are exploring the use of manure digesters, primarily with assistance from state governments.

Depending on their location, many rural areas have great potential to generate electricity from the wind, geothermal resources, biomass, and the sun.

While solar energy currently is often too expensive to compete with wind or conventional fossil technologies for grid-connected electricity production, it has significant potential in many stand-alone applications on farms and ranches—particularly in remote locations. Photovoltaic solar panels may be cost-effective in applications such as pumping water for livestock, powering automatic feeders, and charging batteries for lighting in out-buildings. Solar energy can also be used to heat water, which can account for 40 percent of the energy used on dairy farms, while solar air heaters can be used to meet the needs of pig and poultry operations, and solar dryers can be used for grains and fruit. An important barrier with solar power is the up-front cost of equipment, which may take 10 years or more to recover. Providing farmers with loan guarantees or low-interest loans to purchase solar equipment could lead to a significant expansion in the

Models of Wind Development



use of these technologies to meet on-site energy needs. In addition, central station thermal solar technology, such as the solar trough systems currently in operation in California and Nevada, may be an option for generating electricity at significantly lower cost than solar photovoltaic systems in some areas and may provide an important new income-generating opportunity for rural landowners in solar-rich areas in the southwestern United States.

Farms can, of course, also be producers of biomass crops for power production. Biopower can be generated using prairie grasses or fast growing woody crops (poplar and willow, for example) that are either burned in existing coal power plants with some modifications, or converted to combustible gases using high-pressure gasifiers, where the resulting gas is then burned in gas turbines or boilers. Most biopower is now produced from the waste products of wood processing, such as at lumber and paper mills. A significant biopower industry has existed in California since the mid-1980s using trimmings from orchards. A number of Midwestern utilities have experimented with biopower using dedicated energy crops, including a 10-year study by the Chariton Valley Resource Conservation and Development (RC&D) in Iowa. There, farmers have been harvesting switchgrass from CRP land, which is then burned with coal at Alliant Energy's Ottumwa Generating Station at a rate of 25 tons per hour to produce 35 megawatts of power.

Models of Wind Development

Wind projects being developed throughout the country generally fall into one of two categories: community wind projects or corporation wind projects. Both have certain advantages and are appropriate under different circumstances:

- Community wind projects—for farmers with an ownership stake in community wind projects, greater financial risk and participation is involved, but there is potentially greater financial reward than in the case of utility-owned and developed projects.[27] A number of project development models are available

[27] For a 2004 report, the Government Accountability Office (GAO) requested the National Renewable Energy Laboratory (NREL) to compare the economic impacts of three types of wind power development on 11 counties in five states: (1) a 150 MW project that is owned by an out-of-state firm, (2) a 40 MW project that is owned by an out-of-state firm, and (3) several small projects with total capacity of 40 MW that are owned by county residents. The results varied substantially depending on the population of the county—larger counties were able to capture more of the jobs and economic activity, especially during construction. But the study also showed that locally-owned projects keep substantially more of the benefits in the local economy. For example, a single 40 MW project built in Pipestone County, Minnesota, would generate about $650,000 in new income for the county annually. In contrast, 20 locally owned projects that are 2 MW each (40 MW total) would generate about $3.3 million annually in the same county. [Government Accountability Office (GAO), *Wind Power's Contribution to Electric Power Generation and Impact on Farms and Rural Communities,* September 2004, http://www.gao.gov/new.items/d04756.pdf]

including but not limited to individually owned and financed projects, cooperatively owned and financed projects, local government owned projects and joint projects between local landowners and large equity investors. Generally speaking, the greater the role of local landowners in project development and management, the greater their share of economic benefits should be. Local landowners may be responsible for conducting the wind potential study, forming a corporation, securing the power purchaser agreement (PPA), obtaining government permits, and securing financing for a project. In many cases, a large equity investor, such as John Deere, provides landowners with technical and financial advice, debt and equity investment, long-term management services, turbines, and assistance with the project approval process. Where participating landowners take a greater financial risk and invest substantial sweat equity in a project, they may also reap the greater economic rewards of successful projects.

- Corporation-sponsored wind projects—these projects generally involve less financial risk to the landowner, but also less potential financial reward. Under this model, corporate developers generally lease or buy easements in land from a farmer or rancher for an annual fee of roughly $2000 to $10,000 per year, per turbine. However, project developers may also buy land directly or arrange a lump sum payment for ongoing wind rights. The corporate sponsor provides the financing, installs and maintains the turbines, secures the PPA, and essentially assumes most of the financial risk for the project. The amount and duration of a landowner's return under this approach depends primarily on the commercial terms of a negotiated wind energy development agreement.

Overall, the nation's renewable resource potential is enormous: the Upper Great Plains alone have been called the Saudi Arabia of wind. The wind industry is currently working with the Department of Energy (DOE) to develop a roadmap to produce 20 percent of America's power needs. But despite the fact that costs have declined in recent years, wind and other renewable energy options still face significant technological and market challenges. Cost remains one of those challenges, especially so long as—absent a mandatory program to reduce greenhouse gas emissions—the climate benefits of non-carbon resources are not reflected in market prices. Of the available renewable options, wind energy is among the closest to full cost-competitiveness with conventional technologies, but because the resource is intermittent it is often still at a disadvantage compared to fossil generators that can produce power on demand. Reliability concerns can be managed to some degree by integrating intermittent resources into larger networks and, in the longer run, by developing cost-effective technologies for storing electricity. It is likely that a substantial amount of wind energy can be integrated into existing distribution networks to serve native load prior to the construction of long-distance transmission lines.

Overall, the nation's renewable resource potential is enormous: the Upper Great Plains alone have been called the Saudi Arabia of wind.

Utilities see added value in wind power associated with avoiding the risk of future air pollution regulations and being able to expand incrementally to meet gradually growing demand and are learning how to effectively integrate wind power into their systems. Studies have shown that high levels of wind power can be accommodated into grids with fairly low additional costs, such as by increasing "spinning reserve" or using existing hydroelectric systems for short-term energy storage. A recent order from the Federal Energy Regulatory Commission (FERC) (Order 890) clears away a number of policy barriers to transmission access for wind generation, but much work will have to be required to implement the order.

Furthermore, smaller distributed projects can be hooked to the grid at the distribution level, depending on local circumstances. In many cases, rural low-voltage distribution grids are old and poorly maintained and therefore incapable of handling existing loads, let alone large amounts of new power generation. In these instances, incorporated wind, solar, and biopower generators can actually improve the quality of service in rural areas. Rural areas with three-phase power, which is increasingly common for supplying dairy operations and powering fans and dryers, are good candidates for distributed generation from small clusters of utility-scale wind turbines. Other good candidates include rural businesses with significant

power loads, such as ethanol refineries, grain elevators, and dairy processing plants. In the long run, however, a robust long-distance transmission system is critical for the transmission of wind energy from wind-rich farm and ranch lands to areas without native renewable energy resources.

Financial Incentives and Portfolio Standards: Finding the Right Mix

A variety of policies to promote renewable forms of electricity production have been adopted at the state and federal levels. The existence of these incentives and standards is a reflection of the fact that Congress and many states have recognized the environmental and economic benefits that renewable electricity projects can provide, particularly amid the growing amid mounting climate change concerns. Research conducted for this report highlights the potential economic value that renewable electricity projects can bring to individual farmers and ranchers and rural communities and suggests that additional steps to promote these technologies are warranted. The challenge for the nation will be to adopt policies that fully exploit the significant potential for agriculture-based renewable energy, while allowing electricity providers sufficient flexibility to shift to a low-carbon generation mix in the most economic manner possible.

Federal Production Tax Credit (PTC)

For many years, the federal government has provided a production tax credit for the production of some forms of renewable electricity. The Energy Policy Act of 2005 expanded the number and types of renewable electricity-producing technologies eligible for this credit, which today is worth 1.9 cents per kilowatt-hour (kWh) and is available for up to 10 years for qualifying wind, solar, closed-loop biomass, and certain other types of projects. Open-loop biomass (including agricultural livestock waste), municipal solid waste (including landfill gas), hydropower, and small irrigation hydropower are eligible for a smaller PTC of 0.9 cents per kWh. Since the credit is available only for passive income, the incentive it provides is used almost exclusively for projects in which a large equity investor participates. As a result, the tax benefits of the PTC generally do not accrue directly to local landowners and other small investors.

This credit arguably has been the single most important national-level driver for renewable energy deployment in recent years. The challenge, however, has been that Congress rarely extends the tax credit for more than one or two years at a time. As a result, the renewable electricity industry has tended to move forward in fits and starts and considerable momentum has been lost in the deployment of these technologies. The lack of certainty surrounding the availability of the PTC also has raised the cost of equipment used by renewable energy generators, further exacerbating cost differentials compared to competing fossil-fuel technologies. And perhaps worst of all, the unreliability of the PTC has discouraged domestic investment in the capacity to manufacture renewable energy equipment. While wind and solar projects can be built quickly so as to "lock in" the 10 year tax credit before the PTC expires, manufacturers must make considerable up-front investments in plant, employees, and training. It is lower risk to simply import equipment from Europe and Asia, where countries have established more stable long-term policies. As a result, the United States is missing out on a large number of high-paying manufacturing jobs.

Further, the 10 year term of the tax credit may create an incentive to build projects that can operate in a cost-effective manner for a decade, as this satisfies the demands of large equity investors and project develop-

ers, without creating an incentive for cost-effective operation thereafter when equity investors and project developers typically have no ongoing interests. Extension of the PTC program and modification of its rules to allow the credit to offset non-passive income would significantly increase the impact of this policy on wind energy development, particularly with regard to investment by rural landowners.

Clean Renewable Energy Bonds (CREBs)

Since many utilities—principally rural electric cooperatives and municipal utilities—are not subject to corporate income tax, the production tax credit historically has not provided much financial incentive for these publicly-owned entities to develop renewable electricity projects. During debate on the Energy Policy Act, efforts were made to reconfigure the tax credit to encourage public utilities to invest in renewable electricity projects. Congress did create the Renewable Energy Production Incentive (REPI) for public utilities, a per-kWh payment comparable to the PTC. But since the REPI has to be funded through appropriations every year, lenders have largely refused to fund REPI-financed projects. The solution was to establish a clean renewable energy bond (CREBs) program. CREBs bonds are available only to local governmental entities and as such primarily benefit rural school districts, universities, electric co-

A variety of policies to promote renewable forms of electricity production have been adopted at the state and federal levels.

operatives, and municipal utilities–with only indirect benefits to private rural landowners.

Since its inception, the CREBs program has been extremely popular and currently is oversubscribed. Approximately $2.5 billion in initial applications were made for a total allocation of only $800 million in available bonds. Another $400 million was added to the program in late 2006. The National Rural Electric Cooperative Association is calling for an extension of the program in 2007, with an annual allocation set at $1 billion. The ranking system used in awarding bonds prioritized small projects over large projects to ensure a more equitable distribution of benefits, but as a result the program has not encouraged the construction of larger wind projects by government entities. We agree that this valuable program should be extended and expanded somewhat, with a substantial sum set aside in an equitable fashion for municipal utilities, rural electric cooperatives, and non-utility governmental entities.

Renewable Portfolio Standards

At the state level, renewable portfolio standards—which require a minimum percentage of electricity supplied to be renewably generated—have become a popular mechanism for expanding renewable electricity capacity. Twenty-one states and the District of Columbia now have some form of these standards (see figure III.D). While proposals to establish a national renewable portfolio standard have been considered by Congress, and in fact passed numerous times in the U.S. Senate, this option was not included in the final Energy Policy Act of 2005. Renewable portfolio standards are not without controversy. Many utilities object to their mandatory nature and argue that financial incentives provide greater flexibility and are more consistent with a market-based economy. Without a national portfolio standard, however, it seems unlikely that rural America can realize the full economic potential associated with the development of renewable electricity projects.

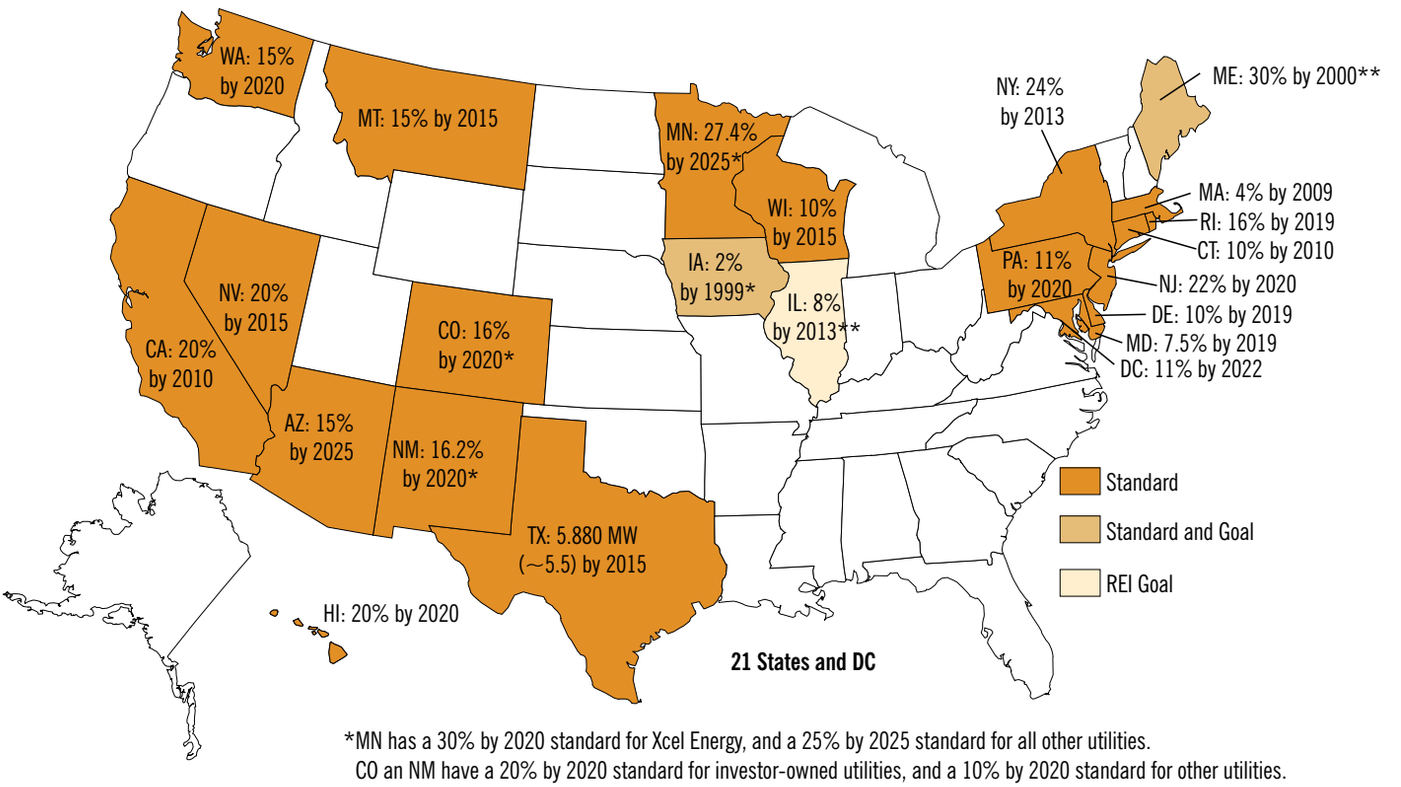
Rural Community Renewable Energy Bonds

A proposal has been made in the U.S. Senate to establish a tax exempt bond program that can be used by rural landowners and other local investors. Its purpose is to provide a federal incentive for local private investment in renewable energy to complement the PTC and CREBs programs, both of which encourage investment only by larger entities, thereby balancing federal incentive programs. This proposal is comparable to the small producer renewable fuels tax credit that has successfully encouraged the development of locally owned ethanol plants. It would be limited to projects of not more than 40 MW, where at least 49 percent of the project is owned by entities resident within 200 miles of the project site.

Title IX of the Farm Bill—Section 9005 Grants

The Energy Audit and Renewable Energy Development Program (Section 9005 of the Farm Bill), was authorized in 2002 to provides grants to eligible

FIGURE III.D: RENEWABLE ELECTRICITY STANDARDS



*MN has a 30% by 2020 standard for Xcel Energy, and a 25% by 2025 standard for all other utilities.
CO an NM have a 20% by 2020 standard for investor-owned utilities, and a 10% by 2020 standard for other utilities.

**In addition to their requirements, IA has a 1,000 MW (~10%) by 2010 goal, and ME has a 10% new resources by 2017 goal. IL has a renewable energy goal, with no specific enforcement measures.

Source: Union of Concerned Scientists (UCS) 2007

entities (e.g., state energy or agricultural office; regional, state, or tribal energy organization; land-grant college or university; rural electric cooperative or utility; or nonprofit organization) that assist farmers, ranchers, and rural small businesses in becoming more energy-efficient and in using renewable energy. Recipients of energy audits supported by this program must pay at least 25 percent of the cost of the audit. With rising energy costs, this program could become a very important tool for farmers to control production costs in the future. According to an analysis by the Environmental Law and Policy Institute (ELPC), if Congress were to provide $25 million in annual funding for an enhanced Section 9005 program over five years, it could fund the following program services, based on 500 grants to eligible entities for program administration and outreach:

Program Service	Level of Support
Capacity building *(e.g. technical field staff, data collectors)*	1250
Energy Efficiency Audits	25,000-50,000
Renewable Energy Assessments	30,000-120,000
Demonstration Farms	85
Multi-County Workshops	1250

ELPC has estimated that this level of investment through the Section 9005 program could save farmers and rural businesses at least $3.5 billion dollars over five years by producing an overall 2 percent reduction in overall energy-related agricultural expenses for fertilizer, pesticide, electricity, and other energy needs.[28]

Title IX of the Farm Bill—Section 9006 Grants

The Farm Bill has provided one of the most effective tools for developing community wind and other farm-based renewable energy projects in the form of Section 9006 grants to promote renewable energy production. Congress has appropriated about $23 million per year since inception in the 2002 Farm Bill. These grants are part of USDA's overall effort to support rural development initiatives. Amounts available are generally limited to $500,000 per project/applicant. These grants provide greater project leverage when compared to the low-rate financing portion of the program or loan guarantees. Grants serve as "down payments" on smaller projects and have played a clear and direct role in enabling many of the types of projects listed on the USDA website at http://www.rurdev.usda.gov/rbs/farmbill/index.html. All of the projects that received awards between 2003 and 2006 will, when completed, result in:

Many of the best wind and solar resources in the nation are located in sparsely populated rural areas.

- 330+ megawatts of wind power and other renewable energy.
- 170 million gallons annually of biofuels.
- Millions of dollars annually in energy savings.
- 1.4 million tons in annual CO_2 reductions.[29]

Overcoming the Transmission Bottleneck

Many of the best wind and solar resources in the nation are located in sparsely populated rural areas. Linking these remote areas to future electricity markets would require substantial investments in extending and improving existing transmission systems. Congress has recognized the challenge associated with providing sufficient transmission capacity to move electricity from ideal generation sites, which are often in remote areas, to distant markets. The Energy Policy Act of 2005 required DOE to conduct a study of transmission congestion and, based on that study, authorized the Department to designate "any geographic area experiencing electric energy transmission capacity constraints or congestion that adversely affects customers as a national interest electric transmission corridor." The law also authorized FERC, under certain circumstances, to issue permits for the construction or modification of transmission facilities within a National Transmission Corridor. These steps are useful and should help encourage the needed siting and construction of new transmission lines. However, they do not fully address the economic hurdles to building new lines. Congress should consider a number of additional steps to ensure that transmission constraints

[28] Personal communication between Eric Washburn and John Moore, Environmental Law and Policy Center, April 2007.
[29] Ibid.

Transmission networks owned by federal power administrations should be expanded to carry new renewable electricity from rural areas.

do not prevent the nation's farmers, ranchers and other private landowners from taking full advantage of the potential to generate and profit from new renewable electricity development.

Paying the Cost of New Transmission Capacity

The issue of who pays for the cost of new transmission capacity has bedeviled Congress, regulatory agencies, and individual utilities for years, and has discouraged the construction of new capacity. Should those producing the energy pay the costs to transport it, or should everyone in the region shoulder the burden? Or is a hybrid approach more appropriate? Should Americans view the transmission grid like the national highway system and be willing to underwrite some of the costs, since in some fashion or another, everyone benefits from a secure, reliable and robust transmission system? Research conducted for this project suggests that much more needs to be done in this area if the nation is to fully develop its renewable electricity resources. And while there is no "silver bullet" solution to contentious cost debates there are a few common-sense steps that Congress should consider to reduce current impediments to needed transmission investments, especially where such investments are needed to access competitive renewable energy production potential in rural areas.

The mix of solutions to this challenge will need to involve clear rules for allocating the costs of new transmission capacity among those in producing areas that will receive revenue from the projects, those in receiving areas that benefit from new projects, and the federal government (based on the national benefits associated with increased renewable energy production). Transmission networks owned by federal power administrations should be expanded to carry new renewable electricity from rural areas. Congress should consider establishing new incentives for utilities to invest in transmission by, for example, cost-sharing transmission projects in key rural areas with exceptional renewable electricity potential and removing restrictions on the ability of private entities to benefit from tax-exempt financed transmission infrastructure, where such construction or expansion is needed to facilitate the interconnection of renewable generators or to deliver renewable energy to consumers. At this point in time, the weight of evidence suggests that if tax exempt financing is provided and reliable cost recovery assured, then it is likely that many of the nation's growing transmission needs will be met over time. If that does not appear to be the case, however, DOE should explore additional options for a more direct federal role in facilitating the implementation of, and providing resources for, investments to enhance grid capacity and to promote a more efficient, seamless, and reliable transmission system nationwide.

The Role of the Federal Power Administrations

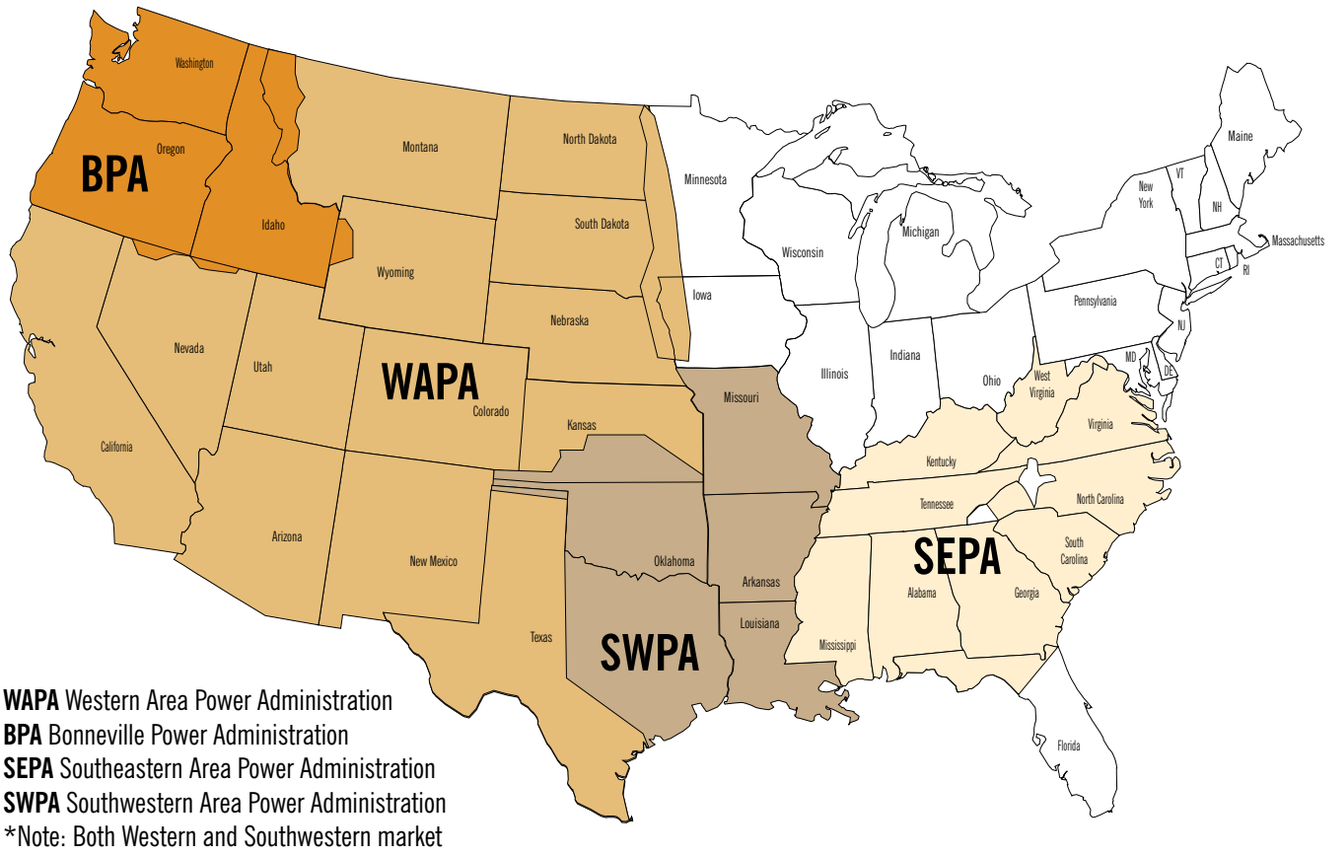
DOE manages a system of power marketing administrations (PMAs) across the country that market federally-generated electricity and own transmission infrastructure (see figure III.E). Much of the transmission capacity associated with the PMAs is located in areas rich in renewable wind and solar resources. However, obtaining permission to utilize these transmission lines is often difficult as a result of bureaucratic requirements and lack of available

resources. Two obvious solutions would be to (1) substantially expand the transmission capacity of the PMA system and (2) to legislatively require that applications by renewable electricity projects for access to these transmission lines should receive streamlined consideration and preference over non-renewable projects. For example, in the Upper Midwest, where there is greater potential for wind power generation than anywhere else in the country, the Western Area Power Administration (WAPA) markets power from a series of dams along the Missouri River. Expanding the transmission capacity of those lines would avoid the need to site new transmission corridors and could be achieved through a simple act of Congress. In the meantime, WAPA should be encouraged to integrate wind power into its hydroelectric operations and to allocate any excess transmission capacity in its system to new renewable energy projects that are being contemplated in the region, while it moves to expand the capacity of its lines.

The Role of Regional Transmission Organizations

A number of regional transmission organizations (RTOs) have emerged around the country to facilitate the reliable and efficient transmission of electricity. RTOs have proven to be a valuable mechanism for achieving this goal, since they provide a centralized mechanism for coordinating among many owners of transmission lines and for avoiding the "pancaked" rate-tolling system that discourages long distance transmission of electricity across multiple states. Large, regionally interconnected power markets, such as those that exist in Northern Europe and the northeastern United States, are capable of accommodating variable wind resources relatively easily. In contrast, throughout much of the western United States and Great Plains, "control areas" operate as small systems with relatively little generation that can be dispatched up and down to serve electric load. These systems are less able to integrate variable resources like wind and solar energy. Utilities in these areas should be

FIGURE III.E



WAPA Western Area Power Administration
BPA Bonneville Power Administration
SEPA Southeastern Area Power Administration
SWPA Southwestern Area Power Administration
*Note: Both Western and Southwestern market power in Kansas.

Source: United States Department of Energy (DOE) 1999

encouraged to join RTOs. Until they can join larger markets, utilities should be encouraged to take steps to match the outcomes of larger, organized markets in terms of facilitating an increased contribution from wind resources. In areas where RTOs may not materialize, incentives could be provided to utilities that balance their systems in a cooperative fashion.

Energy Corridors

As noted previously, the Energy Policy Act of 2005 included several provisions to encourage the development of new transmission facilities and remove obstacles that currently hamper the siting of new transmission lines. One of these provisions directs the Administration to designate "energy corridors" on federal lands. These energy corridors would be the preferred locations for utility rights-of-way and energy infrastructure projects, including transmission lines, oil and gas pipelines, and related infrastructure. The legislation states that the designation of energy corridors should "take into account the need for upgraded and new electricity transmission and distribution facilities to (1) improve reliability; (2) relieve congestion; and (3) enhance the capability of the national grid to deliver electricity." While Congress did not explicitly address the issue in the Energy Policy Act of 2005, it is clear that new transmission facilities will be needed to support the continued expansion of wind and other renewable resources. Many of our best wind and biofuels resource sites are located in remote areas far from electric load centers. Congress should direct DOE and other federal agencies to explicitly consider the location and availability of renewable energy resources when determining energy corridor designations.

Development of Distributed Renewable Energy in Transmission Constrained Areas

Although developing the full potential of renewable energy requires expansion of interstate transmission capacity, until such expansion is built it is possible to insert a substantial volume of renewable energy at minimal cost within rural communities to service local and regional needs. Minnesota is set to investigate the quantity of distributed renewable energy that could be built throughout the state before any substantial upgrades to the regional transmission line grid are completed. Initial estimates suggest that hundreds of megawatts of wind energy can be developed in the near term throughout the state. Given that the permitting, siting, design, and construction of large transmission lines can take years to accomplish, distributed renewable energy development could provide an important bridge opportunity for both corporate and community wind developers until additional large transmission lines are on-line. The federal government can encourage such "bridge" development by streamlining FERC and independent system operator permitting for smaller distributed generation projects.

Does the United States Need a National Grid?

Some rural electric cooperatives are beginning to discuss the efficacy of establishing a national grid. Under this approach, the federal government would develop new transmission lines or upgrade existing interstate transmission capacity to establish a more seamless network of electricity transmission across the entire nation. In theory, the grid would operate like an enormous nation-wide RTO; it would be established under the auspices of DOE and administered by a federal interstate transmission authority. Such a system could be financed through the existing federal budget or through a small levy on electricity (at less than 1 mill—or one-tenth of a cent—per kilowatt-hour). The grid would be akin to the interstate highway system, with on and off ramps, and the goal would be to provide enough capacity to avoid regional

transmission constraints and bottlenecks. Connecting to the system would be voluntary and would not interfere with existing firm transmission rights on the system. Local control of existing systems would not be changed. Local utilities and state regulators would continue operating in their present mode. Given the importance of a robust and reliable transmission system to the nation generally, and to developing renewable electricity projects in rural areas specifically, it is worth exploring this concept further.

In sum, while the agricultural sector can deliver significant renewable electricity production for burgeoning markets, important barriers need to be overcome to realize the full potential of the resource. Key elements of success include ensuring consistency of programs and funding over time and investing in a transmission system capable of delivering electricity generated on farms and ranches to urban areas. In particular, rural electric cooperatives, which serve many agricultural areas, may require substantial inducements to construct additional transmission capacity for the primary purpose of wheeling power to customers outside their service territories. Finally, farmers need to be educated about new renewable energy opportunities and require technical assistance to conduct feasibility studies, and they need access to low-cost financing to purchase equipment for stand-alone applications to serve on-site energy needs. In grid-connected applications, utility companies or other energy developers are more likely to provide project financing, and may offer rental payments to landowners simply for hosting wind turbines or other equipment on their land.

Renewable Electricity Recommendations

To promote renewable electricity production and other renewable energy projects on farms and ranches, Congress should:

- **Establish a national renewable portfolio standard (RPS) along with complementary policies to promote maximum development of cost-effective renewable energy potential on agricultural lands.** Similar policies to promote renewable energy have been adopted by 21 states and the District of Columbia and Congress should now take action to adopt a portfolio requirement at the federal level. Moreover, federal policies to promote renewable energy should encourage the siting of new projects on farm or ranch lands wherever possible. Given that the use of these lands would be far preferable to new development in wilderness areas and would simultaneously provide important economic benefits for rural communities, an appropriate policy goal would be to satisfy at least two-thirds of a national RPS with renewable energy production on agricultural lands. In addition, a federal RPS should be designed to complement and not pre-empt any state requirements (which may be more ambitious) and should apply equally to all large retail electricity providers. (To simplify implementation requirements and to address supply and price concerns, it may be appropriate to exclude rural electric coops and small municipal utilities.)

…energy corridors would be the preferred locations for utility rights-of-way and energy infrastructure projects, including transmission lines, oil and gas pipelines…

- **Expand and strengthen existing programs outside the Farm Bill that promote renewable energy development and related technology advances.** To provide investment certainty, existing renewable-energy production tax credits (PTCs) should be extended for ten years and funding for related research, development, demonstration, and early deployment efforts should be increased. In addition, such programs should be modified so that incentives can be taken against non-passive income. The CREBs program should be extended and expanded, with a substantial sum set aside for the rural electric cooperatives and municipal utilities.

- **Establish a Rural Community Renewable Energy Bonds program to provide a federal incentive for local private investment in renewable energy to complement the PTC and CREBs programs.** This new initiative would be limited to projects of not more than 40 MW, where at least 49 percent of the project is owned by entities resident within 200 miles of the project site.
- **Expand the capacity of the existing federal power administration transmission system.** The federal power marketing administrations (PMAs) own and manage a vast network of existing power lines, which should be substantially expanded to provide the additional capacity needed to tap cost-effective renewable energy resources. Congress should direct the federal power administrations to pursue this objective under a structure in which non-benefiting PMA customers do not shoulder the cost and preference is given for system investments that maximize promising opportunities for renewable energy development on agricultural lands. Priority should be placed on the expansion of the WAPA and BPA transmission systems. The PMAs also should be authorized and encouraged to enter into partnerships with non-federal parties for the siting, planning and construction of transmission lines; the participation of PMAs can streamline siting by avoiding multiple state siting authorities.
- **DOE should designate the Heartland Transmission Corridors "National Interest Electric Transmission Corridors" pursuant to the Energy Policy Act of 2005.** Federal assistance in the form of an expanded role for WAPA as a facilitator for planning and investment, and a 20 percent matching investment from the federal government would go a long way toward addressing cost and siting hurdles, encouraging state cooperation, and ensuring that needed transmission system enhancements are implemented.
- **Congress should authorize $1 billion per year for five years to provide tax-exempt bonds for the construction of transmission facilities (or the expansion of existing facilities) where such construction or expansion is cost-effective and offers substantial public policy benefits in terms of facilitating the development of clean, domestic renewable resources.** Under such a program, loans would be provided by eligible government entities to qualified private entities seeking to finance eligible transmission infrastructure. Such bonds would assure the availability of financing for transmission at significantly lower cost than presently available in the market. They could be used both for new transmission and for upgrades to existing facilities (for example, to address transmission constraints in west Texas and Minnesota, where substantial wind development opportunities exist, or to access renewable energy projects anticipated as a result of the Rocky Mountain Area Transmission Study (RMATS) in the Western Interconnect. In addition, current private-use restrictions applicable to projects that receive tax-exempt bonds should be reviewed to assess whether they create unnecessary additional hurdles to investment.
- **Explore further opportunities for an expanded federal role in directly facilitating the implementation of, and providing resources for, investments to enhance grid capacity and to promote a more efficient, seamless, and reliable transmission system nationwide.**
- **Reauthorize and expand USDA's Energy Audit and Renewable Energy Development Program under Section 9005 of the 2002 Farm Bill.** This program to assist farmers, ranchers, and rural small businesses in becoming more energy

efficient and in using renewable energy technology and resources has never been funded. It should be reauthorized with a goal of performing audits of 25 percent of all farms and ranches over the time horizon covered by the next Farm Bill and funds sufficient to achieve that goal should be appropriated in the future.

- **Reauthorize and expand USDA's Rural Development Business Renewable Energy and Energy Efficiency Program** (Section 9006 of the 2002 Farm Bill). This program currently provides a modest number of grants—$23 million per year—to support renewable energy and energy-efficiency projects. Future funding should be scaled up over the next 5 years to at least $500 million per year and the program should be expanded to enable participating agencies to provide grants for feasibility studies and loan guarantees for project development. As long as feasibility studies are accurately performed, the cost to the federal government of providing loan guarantees for up to 75 percent of project costs should be fairly small. In addition, Congress should consider modifying the program to (1) increase loan guarantees for cellulosic ethanol facilities to at least $100 million per project, and $25 million for other projects, (2) create a rebate program to streamline the application process for smaller, standardized projects by reducing the paperwork burden, and (3) expand eligible applicants to include agricultural operations in non-rural areas (such as greenhouses) and schools.

C. Carbon Sequestration

As scientific evidence and public awareness grow, policy action on global climate change at the federal level appears increasingly inevitable: a question not of "if" but rather of "when" and "how." In June 2005, the U.S. Senate adopted a resolution expressing its sense that "Congress should enact a comprehensive and effective national program of mandatory, market-based limits and incentives on emissions of greenhouse gases that slow, stop, and reverse the growth of such emissions." Agriculture, like all other sectors of the economy, would bear some share of the cost burden associated with regulating greenhouse gas emissions. At the same time, however, agriculture is in a unique position to deliver needed emissions reductions required by such mandatory limitations, not only by supplying increased demand for climate-friendly biofuels and renewably generated electricity, but also by providing significant emissions reductions and emissions offsets in the form of soil carbon sequestration. In particular, agriculture can provide considerable low-cost near-term reductions, and thus act as a bridge to a time in the future when technological advances will allow steep reductions in emissions from fossil-fuel power plants. In the long run, biofuels production has the potential to make the largest contribution to this mitigation potential. As noted previously, a new analysis conducted for this project finds that the potential business opportunities associated with mandatory carbon regulation would far outweigh costs incurred as a result of higher fossil-fuel prices.

Unlike other forms of sequestration being considered (i.e., ocean and geological), terrestrial sequestration is a proven technique. Agriculture and forestry already are reducing net U.S. emissions of greenhouse gases every year (U.S. EPA, 2006). At present, carbon uptake by forests and agricultural soils is estimated to absorb approximately 780 million metric tons of carbon dioxide per year, an amount equal to about 11 percent of total U.S. greenhouse gas emissions. Forests, however, account for the vast majority (90 percent) of this sequestration. The agricultural sector, by contrast, is a net emitter: releases of methane (CH_4) and nitrous oxides (N_2O) from farm-based sources such as feedlot operations and fertilizer use are currently estimated to account for 6 percent of total U.S. greenhouse gas emissions. In the future, mandatory limits on green-

TABLE III.A
KEY MITIGATION STRATEGIES IN AGRICULTURE AND FORESTRY

Mitigation Strategy	Nature of Mitigation	GHGs Mitigated		
		CO_2	CH_4	N_2O
Afforestation	Sequestration	X		
Rotation Length	Sequestration	X		
Timberland Management	Sequestration	X		
Deforestation (avoided)	Sequestration	X		
Biofuel Production	Fossil Fuel Substitution	X	X	X
Crop Mix Alteration	Emission Reduction, Sequestration	X	X	
Rice Acreage Reduction	Emission Reduction		X	
Crop Fertilizer Rate Reduction	Emission Reduction	X	X	
Other Crop Input Alteration	Emission Reduction	X		
Crop Tillage Alteration	Sequestration	X		
Grassland Conversion	Sequestration	X		
Irrigated / Dry Land Conversion	Emission Reduction	X	X	
Livestock Management	Emission Reduction		X	
Livestock Herd Size Alteration	Emission Reduction		X	X
Livestock System Change	Emission Reduction		X	X
Liquid Manure Management	Emission Reduction		X	X

Source: EPA 2006

house gases will create new carbon markets that will reduce these contributions considerably.

Greenhouse Gas Reduction Techniques

Agriculture has the potential to contribute much more to the national effort to reduce atmospheric concentrations of greenhouse gases by enhancing carbon absorption through changed agricultural practices, like low-till or no-till cultivation, which allow the soil to absorb and retain more carbon and by other practices. Analyses of the additional sequestration potential of the nation's existing croplands alone range from 260 to 810 million metric tons of carbon dioxide ($MMTCO_2$) per year.

Similarly, although U.S. grazing lands currently emit an estimated 43–70 $MMTCO_2$ per year, scientists estimate that by undertaking practices such as land conversion and restoration, an additional 70–170 $MMTCO_2$ per year could be sequestered on grazing lands (Follett, 2001). Future policies might consider targeting changes in management practices on grazed lands simply because of the substantial area of lands involved: a total of 824 million acres nationwide, of which 524 million acres are privately owned and 124 million acres are publicly owned. This comprises more than twice the area of U.S. cropland.

Table III.A lists the primary greenhouse-gas mitigation options available to farmers and foresters, including both options for sequestering carbon and for avoiding emissions. Tree planting can produce substantial sequestration benefits, storing up to 5–10 metric tons of carbon dioxide per acre per year over a timber rotation of 20–50 years (USEPA 2006). Given significant new demand for agricultural lands for bioenergy crops, however, large-scale conversion of existing cropland to forests seems highly unlikely. But substantial greenhouse gas benefits can also be achieved by altering crop rotations or tillage practices, or by taking marginal land out of production and planting it to native vegetation, as is frequently done on lands enrolled in existing conservation reserve programs.

Wetland restoration also has the potential to store significant amounts of carbon. In one study in the Prairie

Pothole Region of the United States and Canada, researchers determined that wetland restoration had the potential to sequester twice as much carbon as conversion of all cropland in the region to no-till. However, some of the greenhouse gas benefits associated with wetlands may be offset by the release of methane and nitrous oxide. Wetland restoration also produces important environmental and agricultural co-benefits, such as reducing soil erosion and nutrient runoff and improving soil fertility and productivity, and improving wildlife habitat and water quality.

Opportunities also exist to reduce emissions through more targeted fertilizer applications and technologies, and through additional crop and livestock management practices. Finally, new technologies—such as advanced biofuels production processes or anaerobic digesters that convert animal waste to methane which can be used to generate electricity—can allow farmers to produce valuable energy outputs and to achieve greenhouse-gas reductions by displacing fossil-fuel use. A promising technology pyrolyzes forest or agricultural biomass to form a charcoal product known as biochar or agrichar which retains 30–50 percent of the biomass carbon. Use of biochar as a soil amendment has been shown to boost plant growth and create stable soil carbon pools, reminiscent of the highly

Wildlife groups also see the potential benefits of farm- and forest-based carbon sequestration projects.

fertile Terra Preta ("dark earth") soils of the Amazon basin, which were also created with biomass char. The remainder of the biomass carbon can be captured as bio-oils or bio-gases for on- or off-site energy needs. This technology offers much promise for agricultural sustainability and enhanced, stable soil carbon sequestration. Cost estimates for farm-based greenhouse-gas mitigation opportunities range from $5 per metric ton for agricultural soil carbon sequestration and forest management to $15–30 per metric ton for afforestation (Rice and Reed, 2007).

Existing Voluntary Carbon Markets for Producers

In the past, farmers and farm organizations have disagreed about whether a warming climate is likely, in net, to be positive or negative for agriculture, though most share the concern that mandatory greenhouse gas controls will result in higher energy costs. At the same time, however, many farmers are very interested in carbon sequestration opportunities as a potential new source of future income. Both the National Farmers Union and the American Farm Bureau endorse the concept of paying farmers to sequester carbon in soils and believe farmers should be allowed to participate in markets for carbon credits. In fact, the National Farmers Union has launched a project to serve as an aggregator of credits that it trades on the voluntary Chicago Climate Exchange (CCX) for its members in 14 states. Similarly, the North Dakota Farmers Union, the Iowa Farm Bureau, and the state of Illinois have established programs that allow farmers to generate carbon credits that are sold on the CCX for between $2 and $4 per ton. The Iowa Farm Bureau currently aggregates carbon credits from farmers in Iowa, Nebraska, and Kansas and sells them through the Chicago Exchange to universities, industry and other institutions interested in voluntarily offsetting their greenhouse gas emissions. In 2005, 330,000 acres of no-till farmlands were enrolled in the program, which generated a total of $380,000 for participating farmers. Wildlife groups also see the potential benefits of farm- and forest-based carbon sequestration projects. The Association of Fish and

CARBON SEQUESTERED ON AGRICULTURAL LANDS AND POTENTIAL ANNUAL REVENUES FROM SALES

Sale Price of Carbon	260 $MMTCO_2$ per year	810 $MMTCO_2$ per year
$10 per ton of CO2	$2.6 Billion	$8.1 Billion
$20 per ton of CO2	$5.2 Billion	$16.2 Billion
$30 per ton of CO2	$7.8 Billion	$24.3 Billion

Source: Pew Center on Global Climate Change 2006

…a mandatory program for reducing greenhouse emissions could produce substantial net economic gains for rural communities …

Wildlife Agencies has established a Carbon Sequestration Working Group to explore these opportunities, while Ducks Unlimited already manages its own sequestration program on lands it purchases for waterfowl habitat.

Future Mandatory Carbon Markets

Absent a mandatory regulatory cap and trade program for greenhouse gases, the market for carbon credits is likely to remain relatively small and the value of such credits will, accordingly, remain relatively modest. Assuming a mandatory policy is eventually adopted—as most observers now believe is a foregone conclusion—producers' ability to benefit from reductions generated by the agriculture sector will depend primarily on the ultimate carbon price set by the market and farm-based sequestration and emissions reductions are handled within the larger program architecture.

The potential sale of carbon that can be sequestered in U.S. cropland soils alone, in addition to what is being sequestered currently, is worth anywhere from $2.6 to $24.3 billion annually in a functioning greenhouse gas market, depending on the sale price of carbon. These figures are based on estimates by scientists that the potential to store soil carbon on croplands ranges from 260 to 810 $MMTCO_2$ per year, and using hypothetical carbon prices of $10, $20, and/or $30 per ton of CO_2. As noted by studies of agricultural mitigation options for climate change, however, attainment of the upper estimates of this potential will depend on adoption of the right incentives and policies to assist farmers to adopt practices that will sequester carbon (Pew Center on Global Climate Change, 2006).

A useful illustration of the impact of emerging carbon markets for a 1000 acre farm was produced by Chuck Rice and Debbie Reed for their report, "Soil Carbon Sequestration and Greenhouse Gas Mitigation: A Role for American Agriculture," March 2007 (see table III.B). At carbon prices of $4 per ton—roughly the amount available today through the CCX—a 1000 acre farm would generate an additional $3,940 per year. At $10 per ton of CO2, annual income rises to $11,050, while at $20 per ton of carbon, annual carbon market income for a 1,000 acre farm is $22,100.

Other Agriculture-Related Revenue Effects of Carbon Caps

While it is clear that a nationwide mandatory cap on greenhouse gases will create a much larger and more lucrative market for agricultural carbon credits, it should be noted that it will generate other sources of income for producers. For example, carbon caps will increase gasoline prices, which in turn will lead to higher demand for, and market prices for, low-carbon biofuels. California's new Low-Carbon Fuel Standard, which is designed to increase biofuels demand in that state from 955 million gallons today to 3–5 billion gallons per year, provides an early example of this dynamic.[30] Higher demand for low-carbon fuels, in turn, will allow ethanol producers to operate profitably at higher corn prices. Moreover, farmers, ranchers, and other local businesspeople invested in ethanol plants can expect to see higher annual returns on their investments than would otherwise be the case. Carbon caps also will create demand for biomass that can be co-fired with coal and other fossil fuels in power plants to reduce carbon emissions associated with electricity production. Finally, higher energy costs will encourage farmers to shift to less energy-intensive practices like low-till and no-till farming. To some extent, these economic benefits will be offset by higher energy costs, since the ability of farmers and ranchers to conserve energy is not unlimited. The question is whether, on balance, mandatory policies to limit greenhouse gas emissions will create net costs or net benefits for agricultural producers.

[30] State of California, Office of the Governor. "The Role of a Low Carbon Fuel Standard in Reducing Greenhouse Gas Emissions and Protecting Our Economy." White Paper. 2007.

THE 21ST CENTURY FARM: CARBON CREDITS AND INCOME GENERATION

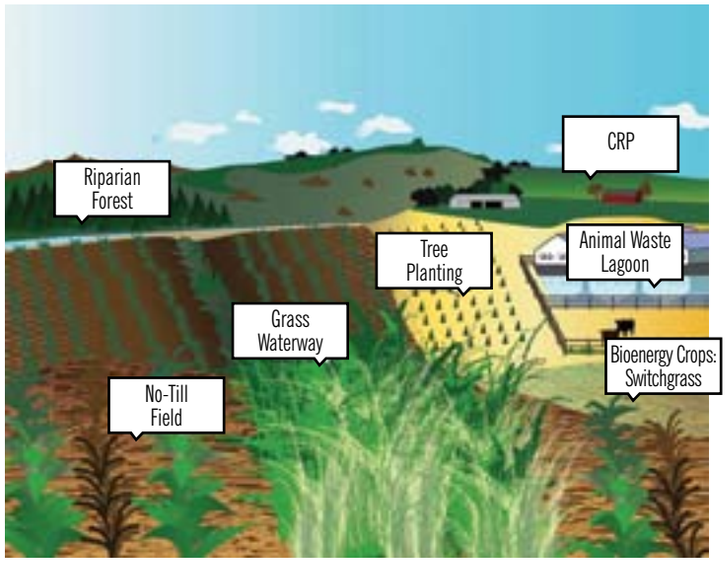


TABLE III.B
THE 21ST CENTURY FARM: POTENTIAL ANNUAL INCOME GENERATED FROM CARBON CREDITS ON A "MODEL" 1,000 ACRE FARM

Practice	Soil MT CO_2/a/y	Area (acres)*	Total Soil Credit	Value $4/Ton	Value $10/Ton	Value $20/Ton	Other Credits[1] CO_2/a/y	Value $10/Ton
Riparian Forest	NA	40					0.70?	
Grass Waterway	3.00	50	150	600	1500	3000		
Tree Planting[2]	0.45	100	45	180	450	900	0.70	700
CRP	3.00	100	300	1200	3000	6000		
Bioenergy grass crop	0.20	200	40	160	1600	3200	5.0	10000
No-till Field	0.75	500	375	1500	3750	7500		
Anaerobic Methane Digester for Animal Manure Treatment	NA	50*[3]		300	750	1500	1.5*[3]	750
Total ($)				**3,940**	**11,050**	**22,100**		

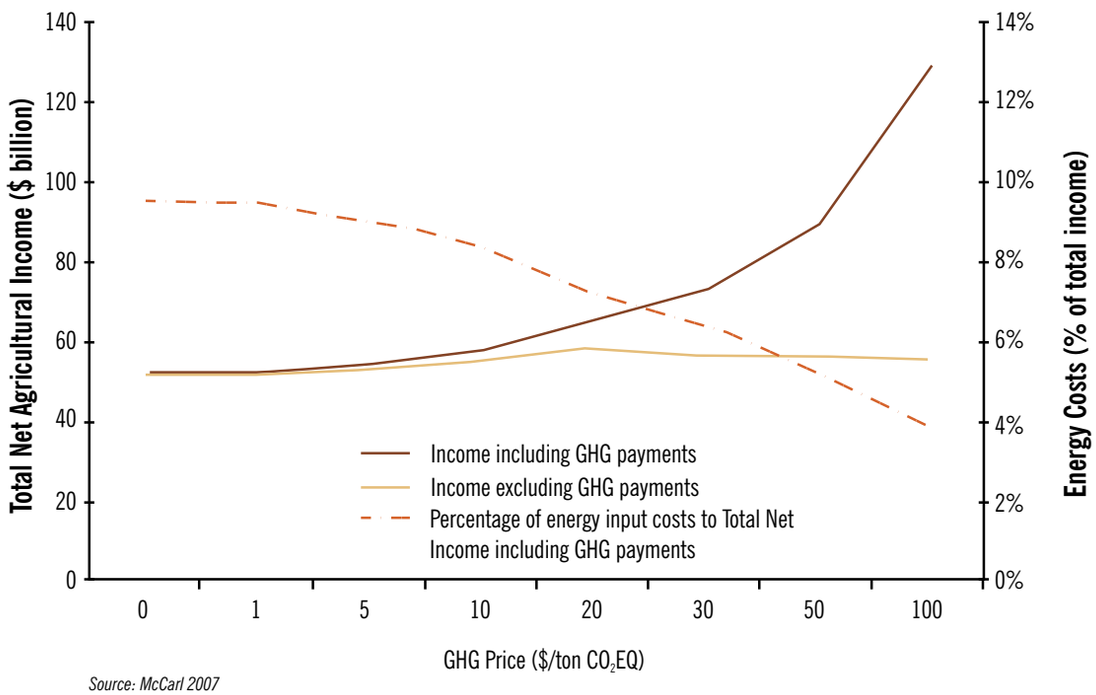
** Figure reported as head of cattle, rather than in acres*

[1] Other credits generated could include: carbon accumulation in woody biomass (Heath et al., 2003a) and from the use of perennial grasses for cellulosic ethanol production, with the ethanol substituting for fossil fuel use (Nelson personal communication), and methane credits (per head of cattle) from managing an animal waste lagoon, with the installation of an anaerobic methane digester.

[2] (Heath et al., 2003b)

[3] The amount of credits awarded by CCX in association with use of an anaerobic methane digester to handle cattle manure is approximately 1.5 MT CO_2/head/year (Personal communication with Dave Miller, Iowa Farm Bureau, 2007).

FIGURE III.F: AGRICULTURE INCOME AND ENERGY COSTS: CARBON-CONTRAINED WORLD WITH $2.00 GASOLINE PRICES



Source: McCarl 2007

Net Economic Impacts of a Mandatory Nationwide Greenhouse Gas Emission Cap

An analysis undertaken for this project by Dr. Bruce McCarl of Texas A&M University looks in detail at the potential for national climate policy to generate both new costs and new sources of revenue for the agriculture sector. It concludes that a mandatory program for reducing greenhouse emissions could produce substantial net economic gains for rural communities if it is implemented in a manner that specifically takes advantage of the agricultural sectors' ability to provide lasting, low-cost greenhouse gas reductions in the form of soil carbon sequestration and low-carbon energy sources. Enactment of a nation-wide cap on greenhouse gases will promote the generation, trading, and selling of carbon credits, thereby creating substantial new economic opportunities for farmers and entrepreneurs engaged in these practices. Dr. McCarl examined the implications of a mandatory cap on greenhouse gas emissions, assuming $2.00 per gallon wholesale gasoline prices (typically about $0.50 per gallon lower than retail prices) across the range of carbon-dioxide-equivalent greenhouse gas offset prices. His analysis focused on:

- total net farm income—total net farm income with greenhouse gas payments
- total net farm income without greenhouse gas payments—equal to net income from conventional sources.
- energy input costs—costs of energy inputs, including carbon credit payments for embodied emissions from, for example, diesel fuel.

Figure III.F present the results graphically. The red line represents net farm income under a mandatory carbon cap (with carbon credit payments to farmers for sequestration as well as other economic benefits from biofuels and biomass-to-electricity). As carbon prices rise, greenhouse gas credit payments and the economic benefits associated with biofuels use and other agriculture-based enterprises cause net farm income to rise substantially. The blue line represents net farm income without greenhouse gas payments to farmers. Income from conventional farming practices—without greenhouse gas payments—rises up to a price of about a $25 per ton of carbon-dioxide equivalent, then stabilizes. This reflects the use of farming strategies that are highly complementary with

conventional agriculture production up to that carbon price. During that initial period (as the carbon price rises to $25 per ton of carbon dioxide equivalent), total on-farm energy costs, such as diesel fuel, initially decline as farmers reduce their energy consumption (e.g., by shifting to no-till cultivation), and net farm income rises slightly. At carbon dioxide prices above $25 per ton, total on-farm energy costs begin to rise, resulting in a loss of net farm income.

Carbon Market Recommendations

To promote markets for carbon sequestration and other cost-effective greenhouse-gas mitigation measures on farm and ranch lands, Congress should:

- **Establish a national, mandatory, market-based program to reduce economy-wide greenhouse gas emissions that provides substantial market opportunities for cost-effective carbon sequestration on farm and ranch lands.** A mandatory market-based national program to reduce greenhouse gas emissions is inevitable and appropriate. A number of states are moving ahead with mandatory greenhouse gas emission reduction programs. The resulting patchwork of regulations will complicate compliance for companies that operate in more than one of these states. Rather than continue down this path, it would make sense to establish a single, uniform national program. Research indicates that potential new revenue streams under a well-designed mandatory program can more than offset costs to farmers and ranchers have the opportunity to participate fully in the carbon markets that will be created under a greenhouse gas trading program.
- **Establish tax incentives, such as federal tax refunds for local and state property taxes, for farmers and ranchers who enroll land in a carbon trading program that works in tandem with entities that buy, sell and trade carbon credits.** Such a program could allow a refundable tax credit for state and local property taxes for land enrolled in a certified, verifiable carbon credit program.
- **Direct USDA to work with other state and federal agencies on continued economic and technical research on different options for sequestering carbon and on better methods of documenting sequestration for market participation.** USDA's Economic Research Service has produced an important study of the "Economics of Sequestering Carbon in the U.S. Agriculture Sector" (Technical Bulletin 1909, April 2004). DOE is developing technical guidelines for carbon sequestration as part of the President's Climate Change Initiative. Both of these agencies should work with the EPA and state and private entities to further the promise of biochar as a soil amendment to considerably increase soil carbon pools in a stable manner that improves fertility while removing carbon from the atmosphere. USDA should invest in further enhancements to the COMET-VR software program that allows farmers and

ranchers to compare the greenhouse gas impacts of various changes in management practices, by adding more types of practices to the database, and by working to validate and reduce uncertainty in sequestration and emissions estimates in the program.

D. Land Conservation and Outdoor Recreational Opportunities

As noted in the previous chapter, America's farmers and ranchers are already heavily involved in land conservation and habitat preservation through existing Farm Bill programs, such as the Conservation Reserve Program (CRP) and the Grasslands and Wetlands Reserves Programs. These programs provide important and valuable environmental amenities, from improving water quality, reducing dust and soil erosion, and recharging groundwater, to protecting natural ecosystems and promoting healthy populations of wild animals, birds, and fish. In many parts of the country, pressure on land resources will continue to grow in the future, both as a result of ongoing, population-driven development in suburban and exurban areas and—depending on the evolving market for biofuels—as a result of growing demand for energy feedstocks. Currently, it is estimated that an average of 3,000 acres of farm and ranch land are converted to other uses and permanently lost to agricultural production on a daily basis.[31]

In this context, programs such as the Farm and Ranch Lands Protection Program (FRPP), which provide federal matching funds to acquire conservation easements from landowners who agree not to convert

[31] American Farmland Trust

their land to non-agricultural uses—can play a critical role in keeping agriculturally valuable land in production. The FRPP permanently protected over 300,000 acres of valuable agricultural land between its enactment as part of the 2002 Farm Bill and 2005. During that time, $215 million in federal funding has leveraged over $550 million from state and local governments and non-governmental entities: a 1 to 2.5 ratio.

The Conservation Security Program (CSP) is another important conservation program first established in the 2002 Farm Bill. It compensates farmers and ranchers for engaging in a range of conservation practices on working lands and as such effectively complements the existing suite of set-aside programs. While in concept it is popular among farmers and ranchers, it has suffered from incomplete implementation since its inception.

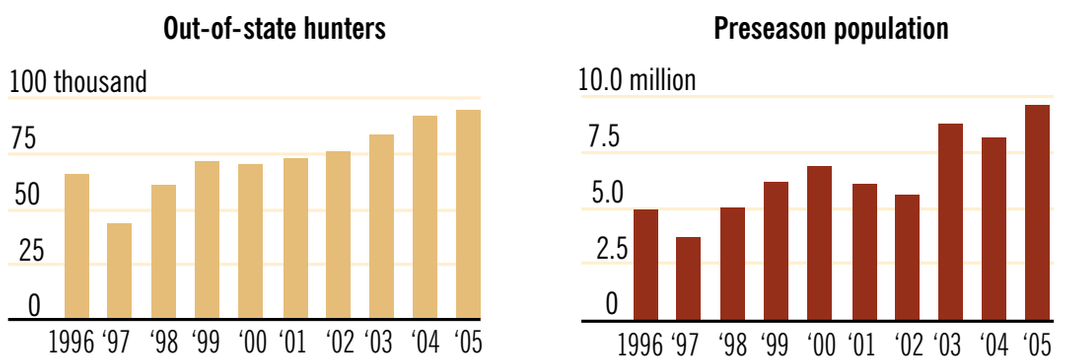
Well-designed policies and programs such as the CRP, WRP, GRP, FRPP and CSP can help farmers and ranchers meet conservation-oriented objectives while also serving the considerable market that exists for access to hunting, fishing, bird-watching and other recreational outdoor activities, as well as future markets for carbon sequestration and other environmentally beneficial goods and services. Farmers and ranchers are expected to receive an average of $4,143 per participating farm under CRP, for a total of $1.76 billion in 2006 (Hallinan 2006); these revenue streams could be augmented, perhaps substantially, if landowners participating in the CRP were able to avail themselves of the growing market demand for high quality places to hunt, fish and recreate. USDA reports that the wildlife benefits associated with the CRP result in $1.4 billion in direct expenditures for waterfowl hunting, up to $3.1 billion for small game hunting, and $4.1 billion for other wildlife-related recreation. In South Dakota, for example, CRP is credited with providing world-class pheasant habitat, which has produced consistent increases in the state's pheasant population for the last decade, and a concomitant increase in the number of out-of-state hunters (see Figure III.G). This has resulted in an economic boon to the state's economy, with pheasant hunters spending $153 million in South Dakota last year (Hallinan 2006).

…America's farmers and ranchers are already heavily involved in land conservation and habitat preservation through existing Farm Bill programs…

Many states have established programs to encourage farmers and ranchers to expand public access by, for example, offering rural landowners per-acre payments to voluntarily open their lands for hunting and other forms of outdoor recreation, and to improve habitat. Landowners with lands enrolled in the CRP and other habitat-enhancing programs are considered particularly valuable participants in these access initiatives, and in many cases are given preference for scarce state program "walk-in" program funds. Such "walk in"

FIGURE III.G: A CALL TO ARMS

Number of out-of-state hunters and pre-hunting season population of ring-necked pheasants in South Dakota



Source: South Dakota Game, Fish and Parks Department

Well-designed policies and programs…can help farmers and ranchers meet conservation-oriented objectives while also serving the considerable market that exists for access to hunting, fishing, bird-watching and other recreational outdoor activities…

programs have been effective and popular because they expand opportunities for sportsmen and deal effectively with landowner liability concerns. Applications to enroll lands in these state programs have far outstripped available funding, however. To address this shortfall, bipartisan legislation called the "Voluntary Public Access and Habitat Incentive Program of 2005," or "Open Fields Bill," has been introduced in both houses of Congress. This legislation would authorize USDA to provide state agencies with $20 million per year for five years to bolster existing state access programs and promote new programs where they don't currently exist.

Conservation Recommendations

To advance widely supported objectives in terms of environmental improvement, habitat preservation, and open space protection while creating additional sources of income for farmers and maximizing potential business opportunities related to hunting, fishing, and other forms of outdoor recreation, Congress should:

- **Expand certain conservation programs.** Specifically, the Conservation Reserve Program cap should be kept at 39.2 million acres. A significant amount of the increased acreage should be used to enroll land in filter strips, wetlands with upland buffers, and riparian buffers to protect water quality. The cap on land enrollment for the Wetlands Reserve Program should be raised to at least 5 million acres, the cap on enrollment in the Grasslands Reserve Program should be raised to 5 million acres, and yearly enrollment in each program should be increased to a minimum of 250,000 acres and 500,000 acres respectively. Additionally, USDA's policy to allow farmers to sell or trade soil carbon sequestered on CRP lands should be expanded to allow the sale or trading of soil carbon sequestered in the WRP, the GRP and other conservation programs. These policies should specifically be incorporated into future mandatory GHG emissions reduction policies, providing an additional source of potential income for these societal benefits. Funding for the Farm and Ranch Lands Protection Program should be increased to at least $300 million per year. It is likely that these "green box" programs will continue to be legal under future GATT trading rules, and thus will provide an acceptable means of achieving conservation goals and providing income to landowners.
- **Pass bipartisan legislation to enhance public access to farm and ranch lands for hunting, fishing, and other outdoor recreational activities.** Specifically, a bill introduced under the title "Voluntary Public Access and Habitat Incentive Program of 2005" or simply known as the "Open Fields Bill" would provide $20 million per year in federal funds to supplement state "walk in" programs that give farmers and ranchers financial incentives to expand public access to their lands.
- **Implement the Conservation Security Program (CSP) on a nationwide basis.**

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