Center for American Progress

Fueling a New Farm Economy

Creating Incentives for Biofuels in Agriculture and Trade Policy

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Progressive Ideas for a Strong, Just, and Free America

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Table of Contents

Executive Summary

Complex problems require detailed solutions underpinned by a clear vision of the future. When each of those problems individually seems almost intractable, the need for an overarching view of the desired outcome becomes all the more important. Without a doubt that is the case today when policymakers confront global warming, global poverty, energy security, and global free trade.

All four issues boast numerous problems and challenges. Yet consider a vision of the world where renewable energy extracted sustainably from crops and agricultural wastes across the planet fuels a new farm economy that simultaneously produces food and fuel amid economically robust and environmentally sound rural landscapes. This new way of thinking about agriculture and rural communities worldwide offers a way past our world's unsustainable reliance on fossil fuels and our inability to build a global trading community that enriches farmers worldwide. Once embraced, this new vision offers humanity a viable approach to help reverse the dire effects of climate change.

These are bold visions. The tools needed to craft this new rural economy, however, are within the grasp of the new 110th Congress, which this year must reauthorize our nation's farm legislation. At the same time, the latest round of World Trade Organization negotiations remains on the brink of final collapse due to seemingly insurmountable disputes over farm subsidies and tariffs. Congress this year has the chance to hurdle past these obstacles by enacting agricultural policies that create a clean and prosperous countryside in the United States and around the world.

This paper will detail exactly how Congress can work toward this new vision. Specific policy recommendations are presented in each section of the report so that members of Congress can grasp what needs to be enacted in separate legislative vehicles. In short, this paper is a policymaking roadmap toward that larger vision of growing the world's energy and moving forward constructively on global trade.

The first section, beginning on page 7, presents the current state of play in the U.S. biofuels marketplace and then offers detailed legislative proposals to further boost the burgeoning alternative fuels industry. The purpose: Rapidly and deliberately develop the next generation of advanced cellosic biofuels by:

- Targeting "green payments" to farmers for performing environmental services on their working lands, including growing dedicated energy crops, while decreasing our reliance on commodity-based direct payment subsidies
- Rewarding farmers for agricultural practices that combat climate change
- Increasing funds in the new farm bill for existing renewable energy programs
- Encouraging farmer-owned-and-operated biorefineries and local-owned biofuel plant cooperatives

The second section, beginning on page 12, analyzes in greater detail the advantages and some of the safeguards required in order to bring dedicated energy crops such as switchgrass, miscanthus, jatropha, and poplar to market as biofuels and bioproducts. The incredible potential of these dedicated energy crops to supplement and diversify our energy production, increase rural revenues, and reduce greenhouse gas emissions could allow the United States to substitute 25 percent of our petroleum energy needs with cellulosic biofuels, generate $700 billion of new economic activity on our rural communities and earn farmers $180 billion in new net income within two decades. To get there, detailed policy suggestions include:

- Providing new tax credits and loan guarantees to bring this next generation of biofuels to commercial scale production *now*
- Boosting the Renewable Fuel Standard to ensure demand for new biofuels keeps pace with production capacity
- Lowering the current import tariff on foreign biofuels to further broaden the market for these new alternative fuels
- Reforming current federal support for biofuels to be more market responsive with a countercyclical federal subsidy that ensures that as oil prices rise, federal support for biofuels decreases, and vice-versa
- Extending current Renewable Energy Tax Credits for wind and biofuel production to encourage new investment
- Creating new tax and production incentives for private sector investments in biofuel production infrastructure and clean energy marketplaces

The paper then turns to the complex state of current international trade negotiations in the next section of the paper, beginning on page 18. This section offers clear suggestions of ways to create flexibility in entrenched positions as a means to jumpstart the stalled Doha Round of multilateral trade negotiations, among them:

- Rewarding *all* U.S. farmers for environmental stewardship on their working lands, including growing dedicated energy crops, by implementing a WTO-compatible "green payment" program and encouraging modest reinvestment of current commodity-based subsidies. Other WTO-member nations must make similar farm tariff and subsidy reductions in their agricultural sectors
- Reducing gradually the current 54-cent-per-gallon U.S. tariff on imported biofuels to grow the global market in biofuels and take steps towards meeting the Doha Round's overarching trade and development goals
- Supporting "development-friendly" agricultural support for the world's poorest nations with specific capacity-building and "Aid for Trade" programs involving infrastructure, energy, and other sectors

The final section draws upon the analysis and recommendations of the first three sections to present a vision of a global agricultural economy fully engaged in alternative energy production. This section, beginning on page 20, walks readers through the role of biofuels in contributing to poverty reduction and combating climate change in the developing world and then details how this effort is inexorably linked to U.S. farm policy reforms and a successful conclusion to the Doha Round.

The paper makes a number of suggestions for the United States and our trading partners around the globe to consider, but then turns directly to the need for U.S. leadership at home and abroad to see this alternative energy vision translated into action. Without immediate legislative action by Congress to deliver biofuels to consumers, the overwhelming promise of alternative energy production will take decades longer to bear fruit, and in the process probably bypass the rural communities most in need of a fresh start. Accordingly, the recommendations in this section focus on:

- Creating a nationwide network of service stations selling E85 fuel, a blend of 85 percent ethanol and 15 percent gasoline
- Promoting the sale of Flexible Fuel Vehicles that run on E85 fuel
- Encouraging public awareness of biofuel alternatives in the marketplace through a federal biofuels certification and labeling program
- Boosting research and development in advanced biofuels and biobased technologies through a variety of legislative funding avenues

If all or most of the policy recommendations presented in this paper are acted upon by Congress and matched by our trading partners abroad then it is not hard at all to envision, three decades from now, a far wealthier global agricultural sector contributing strongly to a far cleaner global environment and a far more innovative and diversified energy future. It is a vision that transcends political parties and national boundaries. It is a vision that is within reach.

Introduction

The newly seated 110th Congress later this year will have a rare chance to enact a fresh set of U.S. agricultural policies that could, if carefully crafted, help tackle three of the most daunting problems facing humanity today—global warming, global poverty and the survival of a free and fair global trading system. What's more, such progressive farm legislation, if properly enacted, would enhance our own nation's energy independence and economic prosperity.

These are bold goals. Yet as Congress prepares to debate the 2007 Farm Bill, and as international trade negotiators scramble to pick up the shattered pieces of the Doha Round of multilateral trade negotiations at the World Trade Organization, the time is right for Congress to make the investments needed to jumpstart and then sustain a domestic agricultural economy fueled by clean renewable energy as well as America's traditional farm products.

Thoughtful legislation that nurtures the technology and market mechanisms necessary for a vibrant biofuels industry in the American heartland is a win-win proposition to combat global warming and to enable the United States to push hard for fair and open markets at home and abroad. Moreover, other countries would benefit from these U.S. moves, with many in the developed world already poised to do so immediately, while others in the developing world only needing thoughtful leadership from Washington.

Rising global demand for oil and concerns about the costs and consequences of global warming are contributing fresh momentum to viewing agriculture as a way to diversify our sources of energy for a more secure and renewable energy future. Global interest in farm-based energy—in particular liquid fuels derived from crops and agricultural wastes, or biofuels—is gaining momentum around the world. Indeed, in the first five years of the 21st century, worldwide production of ethanol doubled and production of biodiesel quadrupled.

The United States must rapidly and deliberately develop the next generation of advanced cellulosic biofuels—dedicated energy crops grown in a sustainable manner—and swiftly establish a well-functioning global biofuels market. Such action must become a major component of our efforts to reduce our dependence on oil, diversify our energy sources, combat the devastating effects of climate change, and contribute to a global trading system that boosts rural incomes across the planet.

Reauthorization of the five-year U.S. Farm Bill in November 2007 provides progressives with the opportunity and the responsibility to reinvigorate our traditionally strong commitment to the support of United States agriculture by investing in innovation and the development of this new agricultural market. Congress must improve the competitiveness of our nation's farmers by expanding the modern safety net to serve more farmers and by reinvesting $5.2 billion in commodity-based direct payment subsidies into green payments to encourage producers to grow dedicated energy crops.

Appropriate transition payments and timetables for current farm program recipients, alongside incentives for farmer- and local-owned biorefineries must accompany new farm and renewable fuels public policy. And as biofuel production capacity surges, the United States needs to encourage the private sector to develop growing global market demand for biofuels. In addition, performance-based incentives that reward biofuel producers for efforts to maximize carbon dioxide-reduction methods and conserve water and land resources must be implemented. At the consumer level, cleaner fuels, such as E85 (a blend of 85 percent ethanol and 15 percent gasoline), must be dispensed from more of our fuel pumps, and cleaner cars such as so-called Flex-Fuel Vehicles must be found on more of our roads.

At the same time, the United States has a responsibility to return immediately to the international arena with a proposal to strengthen U.S. agriculture and salvage what remains of the opportunities to make progress on development and global poverty reduction in the current Doha Round of World Trade Organization talks. At the farm gate and in international markets, American family farmers and small-scale farmers in the most vulnerable developing countries share a common goal and a mutual frustration: the incapacity of the global trading system to deliver open markets and a fair price for their products.

The United States can support the participation of more farmers in renewable energy and conservation as well as strengthen the links between large and small producers at home and abroad. We can reach out to key trading partners such as the European Union and Brazil by supporting the reinvestment of agricultural subsidies into support for the research, development, and rapid commercialization of an ambitious advanced biofuels program.

Regrettably, the Doha Round to date has been plagued by countless missed opportunities to both create new markets for U.S. agricultural products and provide a more equitable playing field for small scale farmers in developing countries and U.S. farmers back home. By promoting advanced biofuels and agricultural sector reform, the United States has an opportunity to demonstrate leadership and reinvigorate the multilateral trading system in a manner that contributes to free trade, global economic development, and the establishment of a robust global market in biofuels.

This paper will examine how Congress and the Bush administration can act upon these key domestic and international priorities. Detailed explanations of the benefits of biofuels, alongside specific policy recommendations, are followed by similar analysis and policy prescriptions for the development of celluosic biomass and dedicated energy crops. The links between these two sets of progressive policy proposals and the ongoing Doha Round of WTO negotiations are then explored to illustrate how the Bush administration and Congress can and should embrace bioenergy as a key negotiating position in global trade talks. The United States cannot act alone to fuel a new farm economy around the globe, but we can and should take the lead, beginning this year.

The Advanced Biofuels Opportunity

Farm-based renewable energy and, in particular, biofuels, have the capacity to deliver a secure and stable supply of fuel to supplement our nation's growing energy demands. In combination with improved fuel economy, vehicle technology, public transportation, urban planning, and conservation, the next generation of advanced biofuels can make a key contribution in our efforts to lessen our dependence on fossil fuels, meaningfully reduce greenhouse gas emissions, and diversify our sources of energy.

Advanced cellulosic biofuels derived from bulk plant matter, or biomass, such as corn stalks, wheat straw, and rice hulls, and dedicated energy crops such as switchgrass, miscanthus, jatropha, and fast growing trees can all increase farmers' incomes and create long-term jobs for rural communities in a manner that does not compromise our ability to meet global demands for food, feed, and fiber. The existing vehicle and transportation-fuel infrastructure will require minimal modifications at relatively low cost. And our vulnerability to fuel supply interruptions as a result of natural disasters, terrorism, or aging infrastructure will be reduced by the existence of a newly established network of decentralized biorefineries.

In order to ensure rural communities and family farms in developed and developing countries reap the benefits of the rapidly expanding biofuel-based economy, the United States and our trading partners must bolster their investment in non-food based cellulosic biofuels, dedicated bioenergy crops grown in a sustainable manner, and small-scale farmer-owned and local-owned biorefineries. Many farmers in areas where land and resource conditions are favorable see competitively priced cellulosic biofuels as an opportunity to diversify their crop rotations with the addition of dedicated energy crops, expand the number of farmers throughout the country able to produce potential new feedstocks for biofuels, and increase their profits with the harvesting of agricultural residues.

As we strive to diversify our energy sector to become less dependent on fossil fuels, we must also diversify our current ethanol production efforts to lessen our dependence on traditional ethanol feedstocks that fall short of maximizing reductions in greenhouse gas emissions and overall energy use. Numerous technical and economic challenges remain on the road to large-scale commercial production of advanced cellulosic biofuels, including the need to expand the range, yield, storage, and transportation infrastructure for biomass feedstocks, improve the efficiency of the cellulose-to-biofuel conversion process, and lower cellulosic biofuel production costs. Nonetheless, as we confront the necessity of meaningfully addressing climate change in a carbon-constrained economy, these obstacles are not insurmountable.

Biofuels—The State of Play

In the United States, short term demand for traditional ethanol has increased substantially due in large part to the use of ethanol as a substitute for the fuel additive MTBE, generous federal and state government tax incentives, the Energy Policy Act of 2005's renewable fuel standard mandating the use of ethanol and other renewables in gasoline, and the rising price of oil.

In early 2006, U.S. ethanol production capacity was approximately 4.4 billion gallons per year and represented three percent of domestic fuel use. In the U.S., biodiesel production from organically-derived oils or fats has grown from 0.5 million gallons in 1999 to 75 million gallons in 2005 and is on track to reach 250 million gallons by mid-2007. The number of commercial biodiesel plants has risen from 22 in 2004 to 76 in 2006.

The majority of U.S. ethanol is produced from corn and last year's production was derived from 1.6 billion bushels of corn, or 15 percent of the U.S.'s total projected 10.7 billion bushel corn crop. (One bushel of corn produces approximately 2.7 gallons of ethanol). In 2007, U.S. ethanol production is projected to exceed 6.3 billion gallons and utilize just under 20 percent of the total corn crop. Numerous indicators suggest that as demand for corn increases (and as prices rise), many U.S. farmers are planting more corn and less soybeans and less wheat. The upshot: corn for ethanol production is poised to surpass corn for export in 2007.

Ethanol blenders receive an income tax credit of 51 cents-per-gallon of pure ethanol used in the blending process. This credit will expire in 2010. Ethanol production facilities of 60 million gallons per year or less are eligible for a 10 cent per gallon tax credit on the first 15 million gallons of production. This credit expires in 2008. An import tariff of 54 cents-per gallon is levied on ethanol entering the U.S. from other countries as a means of offsetting the 51 cent income tax credit available to all ethanol blenders. Duty free imports are currently allowed from Caribbean Basin Initiative countries, but the import tariff, in general, is a significant trade barrier.

Almost half the ethanol refineries in the United States are farmer-owned. As more and more biofuel producers have entered the market, the share of production capacity dominated by large producers has actually declined in recent years. Farmer-owned-and-operated biorefineries located in rural communities can take advantage of economies of scale and improved access to investment capital to provide new jobs and support for family farms. Due to transportation costs, most biorefineries are disbursed throughout rural areas and need to be located close to feedstock supplies and local farms.

In the United States, recent industry studies have suggested that ethanol contributes directly and indirectly to the creation of 153,725 jobs and has reduced oil imports by 170 million barrels of oil.[1] At present, there are 101 biorefineries nationwide and 41 new plants under construction. From 2000-2005, globally, one million jobs in the renewable energy industry were biofuels-related, world production of ethanol more than doubled, and production of biodiesel quadrupled. In addition to liquid fuels, biorefineries have the capacity to convert biomass into numerous value-added products, such as biochemicals, plastics, and livestock feed. These co-products represent a crucial source of additional income to plant operators.

Ethanol's energy content is lower than the energy content of gasoline. Estimates vary, but the National Ethanol Vehicle Coalition estimates that a vehicle powered by a blend of 85 percent ethanol and 15% regular gasoline known as E85 has a five percent to 15 percent decrease in miles-per-gallon fuel economy. Biodiesel producers and distributors are eligible for a federal excise tax credit of $1 for every gallon of biodiesel that is blended with conventional diesel. Currently, the most common biodiesel blend in the U.S. is B20, which is comprised of 20 percent biodiesel and 80 percent conventional diesel.

The United States is well on its way to meeting the Energy Policy Act's renewable fuel standard target of raising the minimum amount of renewable fuel in the fuel supply to 7.5 billion gallons by 2012. (One gallon of cellulosic or waste derived biofuel counts as 2.5 gallons of renewable fuel) As the price of oil remains high and projections anticipate ethanol contributing six percent of the U.S. fuel supply by 2010, Wall St. investors are directing significant investment capital towards biofuels and the renewable energy sector as a whole.[2]

Yet as investment and construction activity of new ethanol production plants accelerates, there are increasing concerns that supply capacity will outpace existing demand for biofuels in the market. Some studies indicate that if all ethanol plants currently planned or under construction are brought on line, the U.S. may be producing 18 billion gallons of ethanol per year by 2012. As a result, new and expanded incentives are required immediately to ensure demand for biofuels remains constant and new investment and capital flowing into the industry are not abandoned prematurely.

In the longer term, a joint study by the Department of Energy and the U.S. Department of Agriculture concludes that advanced biofuels have the potential to substitute for 37 percent of U.S. fuel transport use by 2030 and 75 percent of fuel use if vehicle fuel economy is doubled. Globally, the Food and Agriculture Organization has acknowledged the potential of biomass (or biofuels) to meet 25 percent of the world's energy needs by 2025.

They can be overcome in the medium-term with strategic and targeted investments in research and development. In the short term, significant incentives and policy proposals in United States farm policy and at the international level should be mobilized to bring cellulosic biofuels to commercial scale and lay the foundation for a global biofuels market on as rapid a timetable as possible.

Following are specific sets of recommendations to make this happen:

Recommendations

- **Green Payments for Dedicated Energy Crops.** Establish mandatory financial incentives, direct green payments, and low interest loans in the 2007 Farm Bill and other legislation to reward farmers for performing environmental services on their working lands and to encourage them to grow dedicated energy crops such as switchgrass, miscanthus, and other forms of biomass. Decrease our reliance on direct subsidy payments that artificially increase land values, grant disproportionate benefits to large-scale producers, serve fewer and fewer farmers, and make it more difficult for the next generation of small family farms and young farmers to begin farming. Ensure that any savings incurred from deferred farm subsidy payments are reinvested in rural America and in incentives for the research, development, and deployment of biobased fuels and products. Specifically:
  - Reinvest $5.2 billion per year of commodity-based direct payment support into an open, transparent, and verifiable green payment program available to all farmers performing environmental services on their land, including growing dedicated energy crops for use in cellulosic biofuel production.
  - Enact stricter payment limitations to ensure that assistance goes to actual producers. Reduce payment limits to $250,000 per farm from the current $360,000.
  - Maintain a sensible counter-cyclical payment program, but ensure counter-cyclical and marketing-loan payments for cotton and rice are based on the average farm price (as payments are for other program commodities) rather than the usually lower U.S. Department of Agriculture-issued "adjusted world price." Cap counter-cyclical payments at a payment-to-market value ratio of 30 percent. That is, counter-cyclical payments should not comprise more than 30 percent of a crop's market value.
  - Maintain a sensible Marketing Loan/Loan Deficiency Payment, or LDP program, but ensure all marketing loan and LDP payments are based on a seasonal average price, not on the posted-county price. Cap marketing loan and LDP payments at a payment-to-market value ratio of 70 percent. That is, marketing loan/LDP payments should not comprise more than 70 percent of a crop's market value.
  - Establish a comprehensive biofuels transition assistance program to ensure current farm program recipients are eligible for the new program, protect investments and preserve land values, and provide investment certainty for farmers going forward.

- Create an open and transparent database of government spending on farm support and subsidies to increase public accountability and information regarding the amount of agriculture subsidies flowing to particular individuals and/or operations.

- **Reward Farmers for Actions to Combat Climate Change.** Implement policies in the 2007 Farm Bill and other legislation to reward farmers and livestock producers for carbon sequestration, greenhouse gas emissions, and other actions to address climate change by capping the amount of carbon released into the atmosphere and allowing for trading to find the least-cost, market-oriented means to reduce emissions. Performance-based incentives, including the use of carbon equivalence criteria and measurement tools in farming and biofuel production activities should be utilized as much as possible. Potential mechanisms include:

  - Direct payments for carbon sequestration, carbon dioxide, methane, and nitrous oxide greenhouse gas emission reductions taking place on farm and livestock operations. Payments could be administered in a comprehensive "Agriculture and Climate Change" program made available on eligible working lands providing demonstrable greenhouse gas, conservation, and land stewardship benefits, including growing dedicated energy crops, sustainable use of agriculture residue, and greenhouse gas emissions reductions. Such a comprehensive program would likely be WTO "Green Box" compatible and consistent with U.S. WTO obligations. (See details WTO Green Box proposals on page 27).

  - Technical assistance and financial resources to assist farmers and livestock producers in achieving and monitoring reductions in emissions on existing properties. Authorize new funding for basic and applied carbon sequestration research at mandatory spending levels of $50 million per fiscal year. Authorize projects to demonstrate the ability to monitor and verify carbon sequestration, develop carbon management tools for farmers, and raise public awareness regarding the economic and environmental benefits of carbon sequestration.

  These policies can reward the low carbon benefits of advanced biofuels and deliver a triple dividend to farmers in the form of payments for dedicated energy crops, carbon sequestration, and agricultural residue from traditional operations.

- **Increase Funding for Existing Farm Bill Renewable Energy Programs.** Fully fund and expand existing federal commitments to biomass renewable energy in the 2007 Farm Bill and other legislation at a minimum of $1 billion (current authorizations less than $300 million) for existing and chronically underfunded programs including: the Renewable and Energy Efficiency Grant and Loan Guarantee program, Commodity Credit Corporation's Bioenergy program, Value-added Producer grant program, and the Department of Energy's biomass and biofuels program. Encourage further incentives within these programs for the development and production of cellulosic biofuels.

- **Farm-based Renewable Energy Financing.** Establish a dedicated farm-based financial institution in the 2007 Farm Bill or other legislation initially capitalized at $1 billion to specialize in providing essential start-up capital to farmer-owned biofuel facilities and other farm-based renewable energy projects. Specifically:
  - Increase access to capital for rural communities by expanding programs like clean renewable energy bonds; allow local governments and cooperatives to provide grants to help pay for biomass, wind, and solar energy activities on farms and authorized at $400 million.
- **Encourage Farmer-Owned-and-Operated Biorefinery and Biofuel Plant Co-operatives.** Establish direct producer payments at an initial rate of $.10 per gallon and other targeted incentives to farmers engaged in the establishment of farmer and locally-owned biorefineries and biofuel facilities. Take measures to discourage clustering of high-density biofuel production in single geographic regions. Require direct producer payments for locally-owned biorefineries to expire in 2017. Specifically:
  - Maintain the small producer tax credit for biofuels at $.10 per gallon for the first 30 million gallons of production to 2017.
  - Create a cellulosic biofuels (favoring low carbon, dedicated energy crop, agricultural residue feedstocks, and fuel sources) small producer tax credit at $.30 per gallon for the first 30 million gallons of production.
  - Ensure that direct payments and producer credits should only be made available to smaller-scale biofuel facilities of no greater than 40 million gallons of biobased fuels produced each year. Explore the feasibility of providing different levels of direct producer payments to majority locally-owned plants vs. absentee-owned plants to spur and maintain local ownership of integrated biorefineries.[3]
  - Provide technical and financial assistance to encourage farmers to pool resources and enter into larger marketing alliances to enable biofuels and biobased products to enter the retail market efficiently. Ensure small feedstock producers and rural businesses are full participants in the emerging cellulosic biofuel industry.
  - Increase federal research spending dedicated to developing smaller-scale biorefineries and biofuel plants.
  - Establish a grant and loan guarantee program to contribute to construction costs of facilities, storage, and transportation infrastructure for a biobased economy.

U.S. farmers deserve to be rewarded for their contributions to diversifying our nation's energy supply and combating climate change. These recommendations provide the financial tools and policy incentives to enable U.S. agriculture to become a full partner in promoting the next generation of biofuels. At the same time, these ideas provide the foundation for expanding the scope of U.S. farm policy to serve more farmers and to ensure that rural America is the primary beneficiary, through local ownership and value-added production, of this historic transition in the agricultural and energy economies. As the nation moves towards an integrated biobased economy, the public and private sector must provide further incentives to encourage cultivation of dedicated energy crops in a sustainable manner and bring production of advanced cellulosic biofuels to a commercial scale on as rapid a timetable as possible. To this we now turn.

The Promise of Cellulosic Biomass and Dedicated Energy Crops

Cellulosic biofuels made from biomass—agriculture and wood wastes, and dedicated energy crops such as switchgrass, miscanthus, jatropha, and poplar—offer the promise of dramatically lowering the costs of producing biofuels while lessening the potential impact of biofuel production on land use and our capacity to grow food, feed, and fiber. Bringing cellulosic biofuels to commercial scale production, however, will require several key changes to U.S. agriculture and energy policy.

Currently, the production costs for advanced cellulosic biofuels are relatively high compared to traditional ethanol, and cellulosic biofuel has yet to be brought to full commercial scale. Cellulosic biofuel is produced by breaking down the tough and resistant cellulose in plant cell walls into sugars. The sugar molecules are then converted by microbes and fermented into liquid biofuel.

At present, obtaining a reliable and consistent supply of feedstock is one of the largest cost factors associated with traditional ethanol production. Cellulosic biofuels offer an enticing opportunity to move to relatively cheap, abundant, and geographically diverse feedstocks with minimal energy inputs and lower net greenhouse gas emissions.

As we confront the daunting challenge of combating climate change and as our society moves rapidly towards a carbon-constrained economy, cellulosic biofuels offer several advantages. Regular petroleum-based gasoline blended with ethanol reduces greenhouse gas emissions by up to 13 percent; studies indicate cellulosic biofuels produced from switchgrass, miscanthus, and other sources can make significantly greater greenhouse gas reductions. A recent University of Minnesota study concluded that perennial grasses can absorb 4.4 metric tons of greenhouse gases (14 times what they produce) after a decade of growth.[4]

Biomass can generate income for farms and enter the marketplace as an energy feedstock through the following: conversion to liquid fuels as cellulosic biofuel; combustion to generate heat, steam, or electricity; and gasification to synthetic gases to produce diesel fuel, methane gas, and methanol. Moreover, biomass-derived alternative energy is decidedly cleaner than coal-fired ethanol plants now in operation or coming on line.

As natural gas prices have soared, several existing and planned traditional corn-based ethanol plants have recently sought to use coal as an energy source for plant operations. While coal-fired ethanol plants do offer opportunities to reduce natural gas use and produce surplus heat and electricity for the market, the use of coal has raised significant concerns regarding the potential for increased greenhouse gas emissions and air pollution.

At the same time, other ethanol plants have installed biomass gasifiers and are utilizing biomass as a more economical fuel source to generate heat and electricity in the ethanol production process. The result dramatically reduces fossil fuel use and greenhouse gases associated with ethanol production, establishes a reliable and precedential supply chain for biomass feedstock, and offers an opportunity to improve the efficiency of biomass gasification that may allow for the conversion of corn-based ethanol plants to cellulosic biorefineries in the near future.

Other farsighted biofuel production plants are preparing for the future by ensuring their facilities are designed with sufficient flexibility in their production process to allow for the use of multiple forms of feedstock, including corn starch and cellulose. Additional private and public sector incentives to promote the use of biomass and these technologies would produce significant opportunities to reduce fossil fuel use and greenhouse gas emissions.

The cultivation of perennial dedicated energy crops for cellulosic biofuel also uses less petroleum-based fuel than traditional crops. Any excess biomass not converted to biofuels can be used as a fuel source in the cellulose-to-biofuel conversion process in much the same way as biomass gasifiers are replacing natural gas in traditional ethanol plants—or as sugar cane waste is now used as an energy source for cane ethanol refineries in Brazil.

In addition, dedicated high-biomass-yield energy crops such as switchgrass, miscanthus, and others have a higher energy balance than traditional ethanol, emit lower levels of air pollutants, and (due to widespread feedstock availability) have the long-term capacity to produce significantly more ethanol at a commercial level to compete directly with gasoline than traditional ethanol crop-based feedstock. A recent University of Minnesota study suggests that mixed grasses grown on marginal farmland without fertilizers and pesticides would produce 51 percent more energy per acre than corn grown on fertile land.[5] The U.S. Department of Energy has concluded that 1.3 billion dry tons of biomass can be made available in the United States in the near future with modest changes in land use and agricultural and forestry practices.[6]

At present, the United States has approximately 400 million acres in cropland production (corn, wheat, soybean, sorghum, alfalfa, hay, and others). In addition, there is approximately 280 million acres (of a total of 570 million acres) of permanent pasture land potentially suitable for mechanical harvesting. An acre of switchgrass can, very conservatively, produce five tons to ten tons of switchgrass annually, which in turn would produce 50 gallons to 100 gallons of liquid biofuels per ton of biomass. Other estimates range from 12.4 tons per acre and 105 gallons per ton by 2050[7] to 27 tons per acre and 110 gallons per ton.[8]

The Department of Energy has suggested that farmers could grow 188 million dry tons of switchgrass on 42 million acres at a price of less than $50 per dry ton, resulting in total U.S. net farm income gains of $6 billion. In many circumstances, traditional row crops such as corn and wheat generate less income per acre than an acre of switchgrass. In combination with improved fuel economy and efficiencies in cellulosic conversion, 48 million acres (approximately six percent of the crop, range, and pasture land available in the United States) of switchgrass could supply up to 94 percent of U.S. transportation needs.

Recent studies have indicated that with the appropriate investment in research and development, the overall land use requirements of producing enough cellulosic biofuel to fuel half of the U.S. passenger fleet can be reduced to 30 million acres by doubling the per acre yields, increasing conversion efficiency by one third, and doubling the fuel economy of our vehicle fleet.[9] Many production costs are likely to be reduced by the lower costs associated with growing dedicated energy crops in comparison to other crop feedstocks, and ongoing research and development into processing technology.

A recent University of Tennessee study has suggested that over 100 million acres of dedicated energy crops, like switchgrass, in combination with yield increases in major crops, and forest sector and food waste inputs, can contribute toward the goal of offsetting 25 percent of U.S. petroleum use by 2025.[10] The study also forecasted that efforts to reach this goal could result in a total addition to net farm income of $180 billion and potentially generate $700 billion in economic activity throughout the United States.

Dedicated Energy Crops: Switchgrass

Switchgrass (Panicum virgatum) is a fast growing native North American grass also found in South America and Africa. It is a highly adaptable, low maintenance, drought-resistant, and hardy perennial grass that does well on marginal lands in varying climate conditions. As a perennial, it minimizes soil erosion and energy and fertilizer costs because it does not require annual planting or tillage. Switchgrass can be harvested two to three years after planting and twice a year as a cash crop for 10 years with conventional mowers and balers before it needs to be replanted.

In the United States and Canada, research has been ongoing since the early 1990s on the potential benefits of growing switchgrass as a dedicated energy crop for use as a feedstock for cellulosic biofuels and the generation of electricity. In addition to liquid biofuels, switchgrass has demonstrated potential to co-produce other products such as high quality livestock feed and as a substitute for petrochemical polymers to manufacture plastics and derived chemicals.

Dedicated energy crops such as switchgrass and miscanthus offer farmers the versatility of crops with multiple uses, and thereby reduce risks and increase revenue options. Historically, switchgrass has been grown by farmers to serve many purposes, including as forage for livestock, as a buffer strip between fields and around wetlands, and as hedges for soil erosion control.

Switchgrass, miscanthus, and other dedicated energy crops deliver significant environmental and agricultural benefits on the farm and for society in the form of carbon storage (carbon sequestration), enhanced soil quality and conservation, and less overall energy and chemical use during the seed-to-harvest life cycle.

In addition to recycling carbon dioxide from the atmosphere and returning it to the soil, the deep root systems of switchgrass and miscanthus enhance soil fertility by contributing organic matter to the soil. The level of root growth accumulates carbon, uses water efficiently, and is less dependent on energy intensive nitrogen fertilizer inputs and pesticides than traditional crops.

Agriculture has a key role to play in reducing net greenhouse gas emissions in a relatively low cost manner by undertaking multiple activities designed to conserve and capture carbon in the soil and providing low-carbon energy sources such as biofuels. The agriculture sector has the capacity to offset 15 percent of total U.S. carbon dioxide emissions via carbon sequestration in a relatively short period of time.[11] Farmers deserve credit for their efforts to combat global warming and U.S. farm policy should reward farmers who are actively engaged in carbon sequestration practices, including the cultivation of dedicated energy crops and the capacity of these crops to store carbon and improve soil quality.

Dedicated energy crops grown as a no-till crops are ideal for conservation tillage efforts to reduce soil erosion, fuel use, pesticide runoff, and net greenhouse gas emissions. In 2005, 500 no-till farmers in Iowa, Kansas, Nebraska, Minnesota, and South Dakota who leave agriculture residue and waste material on the ground after harvest to enhance soil quality and carbon sequestration received over $750,000 for selling carbon credits on the Chicago Climate Exchange.

As a buffer strip, dedicated energy crops act to slow agricultural runoff and filter pesticides and fertilizers before they enter adjacent waterways. Transportation costs, fuel use, greenhouse gas emissions, and other high energy costs can be minimized by the ability to grow energy crops in a broader geographic area and the capacity to disburse the siting of biorefineries in multiple regions close to population centers throughout the entire nation.

Many dedicated energy crops also enhance biodiversity and provide excellent habitat for wildlife as well as serving multiple conservation and hunting uses. Finally, ash formed during combustion of biomass waste and new technologies involving pyrolyzed agricultural biomass can serve as soil conditioners and soil quality enhancers while contributing to carbon sequestration efforts on working agricultural lands.

Importantly, in order to maximize the environmental benefits associated with dedicated energy crops, these crops must be grown and processed in accordance with effective environmental standards and criteria to ensure sustainable production. Issues to be addressed include conservation tillage, soil erosion and regeneration, carbon sequestration and loss, quantity of water use in cultivation fields and conversion processes, chemical waste products in production, and non-point sources of pollution such as fertilizer and pesticide runoff.[12]

In some circumstances, the use of perennials as dedicated energy crops to produce cellulosic ethanol may offer an opportunity to enhance soil quality on productive lands and reduce soil erosion on marginal lands in these tropical areas. In India, jatropha used in biodiesel production is now cultivated to rejuvenate and bring back into production long-neglected agricultural lands. Nonetheless, the potential conversion of environmentally sensitive lands such as tropical rainforests to agricultural production of biofuels has raised concerns regarding the negative effects that large scale commercial biofuel production may exert on fragile ecosystems and habitats.

In response to these concerns and others regarding the sustainability of biofuel production, numerous initiatives are currently underway around the world to develop criteria, standards, and information-sharing practices regarding greenhouse gas emissions, land-use patterns, and habitat and biodiversity impacts associated with biofuels. For example, the Roundtable on Sustainable Palm Oil has been established to develop and implement standards to ensure sustainable palm oil plantation production for biodiesel.[13]

In addition, the International Energy Agency has established a dedicated task force to monitor and analyze multiple countries' experiences involving sustainable international bioenergy trade.[14] Overall, the establishment of comprehensive certification and labeling sustainability criteria at the domestic and international levels to monitor and communicate the positive and negative environmental attributes of advanced biofuels, including greenhouse gas emissions and soil quality enhancement, is an important policy tool to help ensure the growth of dedicated energy crops and the biofuels industry in a sustainable manner.

Despite the significant advantages cellulosic biofuels and dedicated energy crops bring to present and future biofuel production, major technological, economic, and environmental challenges must be overcome to ensure the viability of large scale commercial production. Overall, cellulosic biofuels will require policy incentives and advances in technology to significantly increase dedicated energy crops' pest and drought resistance, energy yield per acre, and lower process and production costs.

Advances in biotechnology, for example, should be focused on successfully developing an organism to produce enzymes that can perform the dual role of breaking down the resistant cellulosic material and ferment the resulting sugars into cellulosic ethanol more efficiently.[15] The industrial technologies associated with biomass gasification and co-firing of biomass with fossil fuels must also be made more efficient and less costly. (*See details on our specific research-and-development financing proposals on page 33*)

As demand for biofuels gains momentum on a global scale, environmental safeguards, monitoring and access to information regarding production processes through product certification and labeling criteria, carbon management, and land use practices will need to be enhanced in all agricultural regions. The following are specific policy recommendations to ensure these actions are taken:

Recommendations

- **Cellulosic to Commercial Scale *Now*.** Congress should provide immediate funding for production tax credits and loan guarantees to enable the construction and deployment of an advanced cellulose-to-biofuel commercial scale biorefinery capable of producing cost-competitive biofuels and biochemicals in the United States. Specifically:
    - Congress must increase the funding and implementation of production incentives for cellulosic biofuels in Section 942 of the Energy Policy Act from $250 million to $1 billion per fiscal year 2007-2015 and implement immediately the production credit and reverse auction incentives to produce cellulosic biofuels.

- The private sector should establish a "X Prize"-type initiative to offer $10 million in cash rewards for first achievers who accomplish significant breakthroughs in technology and processing that contribute to cost-competitive commercial cellulosic biofuel production.[16]

- **Renewable Fuel Standard.** Amend and increase the existing renewable fuel standard, or RFS, which mandates the use of renewable fuels in the nation's fuel supply, to 15 billion gallons by 2012 immediately and increase incentives for cellulosic biofuels. Incentives should be performance-based and reward efforts to produce sustainable biofuels in a manner that takes into account such overall criteria as carbon equivalence, energy use in production, crop production systems, water conservation, and land stewardship.

- **Biodiesel Renewable Fuel Standard.** Establish a separate RFS for biodiesel mandating five percent biodiesel content for the U.S. diesel fuel pool by 2012.

- **Import Tariff Phase Down.** In combination with an increase in the overall RFS to 15 billion gallons by 2012, the U.S. should gradually begin the phase-down of the current 54 cent-per-gallon tariff on imported biofuels. All countries must take reciprocal action to remove trade restrictions on biofuels.

- **Market Responsive Counter-cyclical Federal Subsidy.** In combination with an increase in the overall RFS to 15 billion gallons by 2012, the U.S. should alter the existing 51 cent-per-gallon subsidy or income tax credit in blending to operate as a counter-cyclical tax related to the price of oil. As the price of oil increases, the subsidy for biofuels is reduced.

- **Renewable Energy Tax Credits.** Extend the existing renewable energy tax credits for wind and biomass until 2010 to encourage investment stability and continuity in the renewables sector.

- **Biofuel Infrastructure.** Create tax incentives for expanding critical biofuel storage, transportation, and distribution infrastructure throughout the nation to ensure access to biofuels in the retail market and the creation of jobs for rural communities.

- **Production Contracts for Clean Energy.** Congress and the private sector should provide resources and technical assistance to promote long-term production contracts between farmers and biofuel processors to create more secure and consistent domestic and international markets for clean energy.

In redoubling our efforts to demand U.S. leadership in bringing advanced cellulosic biofuels to commercial scale immediately, the U.S. will reap significant scientific and technological dividends. Dedicated energy crops grown in a sustainable manner and cellulosic biofuels offer the U.S. the opportunity to expand the geographic scope of biofuel production, reduce energy inputs, and lower net greenhouse gas emissions. The U.S. can seamlessly incorporate many of these policy incentives at the international level to encourage a biofuels industry more responsive to market forces and less dependent on subsidies and tariffs in a competitive global marketplace.

A new emphasis on promoting a global biofuels market coupled with modest agricultural reform will provide the U.S. with greater flexibility to achieve improved market access for all U.S. agricultural and industrial products and achieve a successful outcome to the WTO Doha Round of negotiations. This is the subject of the next section of the paper.

Moving Forward Together: Agriculture, Trade, and the WTO Doha Round

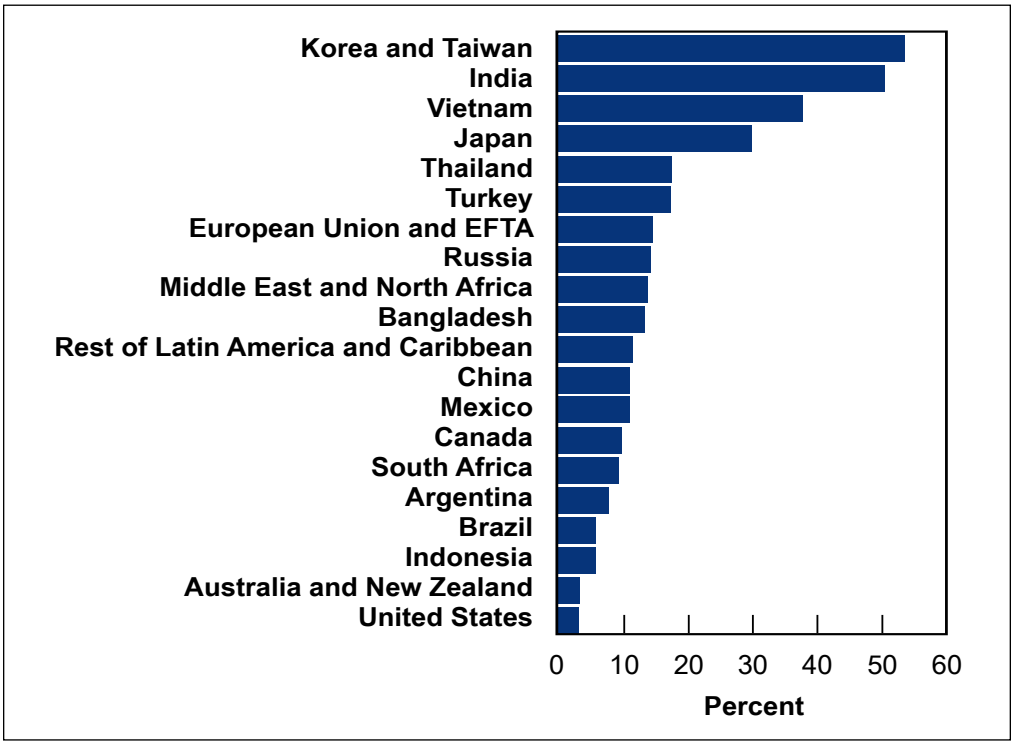
As the United States prepares to reauthorize domestic farm support programs and develop a new long-term agriculture policy in the 2007 Farm Bill and other initiatives, fiscal deficits, market conditions, trade disputes, and negotiations at the WTO will have a profound impact in shaping future farm policy. The United States must return immediately to the multilateral negotiating table with a proactive strategy that does not neglect our farmers back home, generates momentum to establish a well-functioning global biofuels market, and spreads the benefits of international trade and development.

In preparation for the 2007 Farm Bill, and in the wake of recent WTO-based trade challenges to United States farm policy, policymakers are facing difficult decisions with regard to the range of permissible and impermissible domestic farm support programs that they will be allowed to bestow on farmers and other constituents. Even current U.S. farm-based renewable energy programs are at moderate risk of being declared inconsistent with WTO obligations (See Box, page 27).

At the same time, the imperatives of diversifying our energy sources and confronting climate change demand that the United States bolster incentives for advanced biofuels and dedicated energy crops in a manner that earns the broadest support from both domestic constituencies and developing country trading partners. The U.S. must put forward a comprehensive proposal that enhances the modern safety net for a greater number of participating farmers, provides incentives for advanced biofuels and dedicated energy crops, and reaches out to key trading partners such as the European Union and Brazil to make progress on multilateral trade and development. The elements of such a proposal include:

- **Green Payments, Reform of Domestic Support, and Market Access.** The United States should follow through on commitments to eliminate agricultural export subsidies and reinvest $5.2 billion per year in mandatory commodity-based direct payments into an open, transparent, and verifiable green payment program for all farmers performing environmental services on their land, including growing dedicated energy crops. Specifically:
  - Counter-cyclical and Marketing Loan subsidy payment programs can be maintained, but must be adapted to minimize trade-distortions.
  - Green payment programs should be open to all farmers, consistent with WTO rules, and support the greenhouse gas reductions, carbon sequestration, soil quality enhancements, and other environmental services that dedicated energy crops provide for farmers.
- **Our Trading Partners Must Make Similar Commitments.** The EU, Japan, and others must make concrete commitments to eliminate export subsidies and reduce (in real terms) high tariffs and subsidies in their respective agriculture and trade policies. The U.S. and other countries must receive improved market access for their agricultural products. Only a bare minimum of EU and other developed country products should be allowed to be excluded from reductions. Brazil and other leading, emerging developing economies must reduce tariffs on industrial goods and grant improved market access to U.S. products and services in a reasonable time period.

Figure 1— Average Tariff Rates for Agriculture and Processed Foods, 2005



Source: Kym Anderson, Will Martin, and Dominique van der Mensbrugghe, "Market and Welfare Implications of Doha Reform Scenarios," in Kym Anderson and Will Martin, eds., Agricultural Trade Reform and the Doha Development Agenda (New York: Palgrave Macmillan and the World Bank, 2006), Table 12.3, p. 345. Notes: Tariff-rate averages are weighted by imports. EFTA = European Free Trade Association.

- **Biofuel Import Tariff and Environmental Goods and Services.** In combination with an immediate increase in the renewable fuel standard to 15 billion gallons by 2012 and other initiatives, the United States must signal its willingness to begin a gradual phase down of the current 54 cent-per-gallon tariff on imported biofuels. All other countries must take reciprocal action to remove trade restrictions and liberalize trade in biofuels. Consistent with paragraph 31(iii) of the Doha Declaration, all countries should agree to jumpstart the global trade in biofuels by including biofuels in the environmental goods and services negotiations, allowing them to qualify for reductions in tariff and non-tariff barriers on an expedited basis.

- **Development-Friendly Agricultural Support.** In support of the original goals of the Doha Development Round, developing countries should receive assistance to promote "behind the border" capacity-building such as education, transportation infrastructure, and access to private capital. A robust "Aid for Trade" program should not focus exclusively on trade efficiency-oriented measures, such as new technology for customs and inspection, but also on initiatives to achieve broader economic growth and development in developing countries. Specifically:

    - duty free, quota-free access for exports from least-developed countries should be immediately and unconditionally granted.

- Technology transfer, technical assistance, and investment capital should be made available to encourage advanced biofuels and dedicated energy crops in rural communities.
- In overall agriculture negotiations, developing countries in need should be granted reasonable flexibility to allow for the use of domestic support in their agricultural sectors for important public policy goals, such as land reform, food security, and natural disasters.
- Small scale farmers in developing countries should be eligible to have specific crops exempt from full and immediate liberalization.

If implemented, an agreement containing these elements would accomplish several important objectives as part of the effort to improve the competitiveness of farmers in the U.S. and abroad, such as establishing a well-functioning global biofuels market and providing a path forward in the WTO Doha Round. Moreover, this specific round of multilateral trade negotiations can serve as a catalyst for policymakers worldwide to rethink their traditional support for narrow, outdated agricultural policies in favor of win-win farm and energy policies that combat oil dependence, climate change, and rural poverty while fostering fair and open markets worldwide. For this to happen, however, dedicated U.S. leadership will be required.

Fueling a New Farm Economy

Sustained dependence on oil by the United States, other industrialized nations, and many developing countries carries tremendous costs. Globally, dependence on oil threatens economic growth, political stability, and the environment. In agriculture, surging oil and gas prices hit farmers and rural communities in every part of the world particularly hard as the costs of energy inputs at every stage of production and distribution increase while prices for crops lag behind.

In the United States, our national security and capacity to effectively combat terrorism is diminished by our increasing dependence on oil from unstable regions of the world.[17] In the past few years, U.S. dependence on foreign oil has intensified. The percentage of foreign oil consumed domestically climbed to 66 percent in 2006 from 58 percent in 2000. Indeed, many of the nation's leading terrorism and national security experts have expressed the opinion that ending U.S. dependence on foreign oil is a key corrective measure for defeating terrorist networks and enhancing U.S. national security.[18]

Defining the links between these seemingly discrete national security, energy, environmental, and agricultural problems is a complex undertaking. Offering specific solutions that range effectively across all of these different policymaking arenas is even more complicated. Accordingly, the connections between energy policy and climate change in the developing world, in U.S. farm policy, and in international trade negotiations will be examined, each in turn, prior to presenting progressive solutions to these interwined crises for Congress to consider.

Energy Poverty and Climate Change in the Developing World

The relatively rapid emergence of biofuels as a viable portion of the global energy mix offers developing countries an agricultural-based source of energy that can be adapted to meet local conditions and specific energy demands while reducing oil imports and greenhouse gas emissions. Biofuel crops and production can stabilize rural development, provide a potential new source of export income, and help combat poverty.

Africa and Bioenergy

The potential growth of biofuels and integrated bioenergy industries present numerous opportunities and challenges for Africa. In recent years, moderate to high oil prices have forced oil-dependent African nations to divert scarce financial resources away from education, health care, and infrastructure budgets in order to provide subsidies to counter high oil and electricity prices and maintain stability in their respective economies. Since 2002, fuel costs have quadrupled in Niger, and Senegal's direct oil subsidies to domestic consumers have increased fivefold.

In several but not all regions of Africa, the development of a broad-based socially responsible and sustainable bioenergy industry has the potential to harness the advantage of Africa's substantial agriculture, land, water, and labor resources and enable Africa to diversify its energy sources away from imported oil, develop cleaner cooking and heating fuels to serve basic needs, and reduce poverty.

In recent years, total production of ethanol in Africa—primarily sugar and maize-based—has hovered around less than 133 million gallons per year.[19] Nonetheless, investment capital has begun to flow into the continent. In July 2006, a private equity fund allocated $100 million to a sub-Saharan agricultural business that included biofuel refineries in Kenya. On a separate track, Kenya is considering the construction of five new plants to meet the needs of domestic and export markets. In South Africa, plans are underway to build the first of seven biofuels plants at a cost of $1 billion a piece with capacity to produce 133,000 gallons per day and eventually supply 12.5 percent of South Africa's liquid fuel needs by 2015.

Nation-to-nation technical cooperation and financial partnerships are also flourishing. In 2006, energy ministers from 13 African nations formed the Pan-African Non-Petroleum Producers Association, or PANPP, "with the intention that it serve as a green OPEC."[20] The goals of PANPP are to make Africa a leader in biofuels and alternative energy strategies. Brazil and the United Kingdom have announced joint plans to explore major opportunities for biofuel production in South Africa. India, Brazil, and Senegal have announced a biodiesel initiative in which Brazil will provide technological expertise, India investment capital, and Senegal land suitable for jatropha plants and labor. Ultimately, Senegal is aiming to replace its daily consumption of 33,000 barrels of oil per day with biofuels.

In specific circumstances and regions, an increased emphasis on bioenergy in Africa could provide a unique economic development platform. A growing bioenergy industry has the potential to rapidly scale-up agricultural production, diversify crops, expand industrial and transportation infrastructure, and provide new sources of income and jobs in rural communities. Commodity prices for traditional crops such as sugar, maize, and potatoes will increase, as well as opportunities for earned income from carbon management financing. An integrated biorefinery approach will produce not only liquid fuels, but also other value-added co-products such as fertilizer and animal feed. New capital investment and technical cooperation projects will provide investors and communities with a means to meet domestic energy needs and encourage export markets.

Importantly, multiple challenges and obstacles remain stubbornly in place. The development of a bioenergy industry will not be suitable for all regions or areas of Africa. A functioning bioenergy industry will require appropriate climatic and soil conditions, water resources, land availability, transportation and electrical infrastructure, and labor. Policy and regulatory frameworks will need to be in place to ensure increased biofuel production does not compete with food production or lead to widespread deforestation and water use loss. Preliminary studies indicate that a 50 percent increase in crop production in Africa is possible without incurring trade-offs between food and energy.[21]

Bioenergy will not solve all of Africa's energy challenges. Nonetheless, as the recent increase in investment suggests, in appropriate regions and with effective regulatory safeguards, bioenergy has a direct role to play in diversifying Africa's energy sources and contributing to economic growth and development, particularly in rural communities.

Globally, reliable and affordable access to energy for the world's poor is an essential component of poverty reduction and development. At present, more than 2.4 billion people worldwide lack access on a daily basis to modern energy services. In addition, 1.6 billion people lack electricity in their homes. The United Nations estimates that it would cost approximately $15-to-$20 per person per year to provide access to modern energy services to enable the poor to meet fundamental human needs.[22] Economic growth through agricultural production, trade, and development simply will not be possible without access to energy and the means to address climate change.

In developing countries, oil dependence, rising oil and natural gas prices, aging energy infrastructure, and misplaced fossil fuel subsidies impose disproportionate costs on the world's most vulnerable economies. As the handful of net oil exporting countries in the developing world appear increasingly susceptible to the so-called "resource curse" (relative oil wealth contributing to squandered oil revenues, weak governance, and corruption), the vast majority of the world's poorest countries are net importers of oil and 25 of the world's poorest 47 countries are completely dependent on imported oil.[23]

The International Energy Agency estimates that for every $10 increase in the price of a barrel of crude oil, the economy of a Sub-Saharan African oil importing nation is affected more than 10 times as much as the U.S. economy. As a result, rising energy costs are systematically erasing any gains achieved from significant debt forgiveness initiatives.[24]

Biomass, of course, has served for centuries as a major source of energy in the developed and the developing world, in the form of firewood and other combustible material. Today, biomass accounts for 10 percent of global energy use. In developing countries, 2.4 billion people rely on traditional biomass as a source of basic energy and in many developing countries biomass fulfills 80 percent of overall energy needs.[25] With proper technology and financial incentives, these centuries-old energy habits can be transformed into clean energy alternatives and new hope for the agricultural sector in several developing countries.

In many developing countries, agricultural activities employ over half of the labor force and agriculture productivity is a fundamental building block of sustainable economic development and poverty alleviation. The long growing season and tropical climate of many developing countries allows for a choice of multiple feedstocks to support biofuel production and offers developing countries a competitive advantage with developed countries in a global biofuels market.

In rural communities, biofuels can help diversify agricultural and forestry incomes and promote economic activity as new value-added crops and businesses associated with biofuel production are established. Perennial grasses provide greater planting flexibility for developing country farmers because they can be rotated in and out of production as other cash crops become more profitable.

Prices for traditional crops may also improve because cultivating land for biofuels and other products creates positive incentives for improved overall land-use management and land reform. The provision of cleaner cooking fuels, including appropriate biofuel-based products, for 2.4 billion people would have a significant impact on preventing the 1.4 million deaths per year that occur from respiratory diseases related to smoke inhalation from the use of wood burning fires.

Table 1—The Impact of Higher Oil Prices on Select HIPC Countries[1]

Country	Projected Debt Savings from IMF/WB 2006 (US$)	GDP 2005 (US$)	Annual Oil Consumption 2003 (bbl)	Estimated Cost of Oil to Country 2002 (US$)	Projected Cost of Oil to Country 2006 (US$)	Increase in Annual Cost to Country 2002-2006 (US$)	Projected Cost of Oil as % of GDP 2006	Increase in Annual Cost of Oil 2002-2006 as % of GDP	Projected Debt Savings as % of GDP 2006	Public Health Expenditure as % of GDP 2002	Projected Poverty Reduction Expenditure as % of GDP 2006
Mauritania	14 million	1.4 billion	9 million	206 million	524 million	318 million	38.60%	23.40%	1.00%	2.90%	5.50%
São Tomé and Principe	1 million	69 million	0.2 million	6 million	14 million	9 million	20.50%	12.50%	1.40%	9.70%	31.10%
Guinea-Bissau	7 million	280 million	0.9 million	21 million	53 million	33 million	19.10%	11.60%	2.50%	3.00%	5.30%
Sierra Leone	13 million	1.1 billion	2 million	56 million	142 million	86 million	12.60%	7.60%	1.20%	1.70%	4.90%
Gambia	3 million	429 million	0.7 million	17 million	44 million	27 million	10.20%	6.20%	0.70%	3.30%	5.00%
Burundi	21 million	730 million	1 million	26 million	65 million	40 million	9.00%	5.40%	2.90%	0.60%	2.90%
Senegal	72 million	8.0 billion	11 million	266 million	676 million	411 million	8.40%	5.10%	0.90%	2.30%	8.60%
Rwanda	38 million	1.8 billion	2 million	51 million	131 million	80 million	7.20%	4.40%	2.10%	3.10%	10.60%
Ethiopia	78 million	8.8 billion	10 million	231 million	589 million	358 million	6.70%	4.10%	0.90%	2.60%	17.00%
Malawi	40 million	2.0 billion	2 million	47 million	119 million	72 million	6.00%	3.60%	2.00%	4.00%	15.40%
Guinea	23 million	3.6 billion	3 million	72 million	183 million	111 million	5.10%	3.10%	0.60%	0.90%	3.30%
Mozambique	73 million	5.7 billion	4 million	94 million	240 million	146 million	4.20%	2.50%	1.30%	4.10%	17.60%
Tanzania	140 million	12.1 billion	8 million	189 million	480 million	291 million	4.00%	2.40%	1.20%	2.70%	12.10%
Niger	37 million	3.4 billion	2 million	46 million	118 million	72 million	3.40%	2.10%	1.10%	2.00%	6.50%
Burkina Faso	37 million	5.4 billion	3 million	69 million	175 million	106 million	3.20%	2.00%	0.70%	2.00%	5.90%
Uganda	104 million	8 billion	4 million	86 million	218 million	133 million	2.80%	1.70%	1.30%	2.10%	10.70%
Mali	50 million	5.4 billion	2 million	36 million	93 million	56 million	1.70%	1.10%	0.90%	2.30%	7.70%

1. *This survey includes only countries in Africa that have reached either their completion or decision points as of June 2006 under the Heavily Indebted Poor Country Initiative (HIPC) and are 100% dependent on oil imports. These are 17 of the total 29 HIPC countries.*
2. *Projections combine the estimated debt relief under HIPC and the Multilateral Debt Relief Initiative (MDRI) from the International Development Association (IDA) of the World Bank and the International Monetary Fund (IMF) for calendar year 2006. Data does not include debt assistance provided by the African Development Fund (AfDF), the third multilateral institute involved. Debt owed to the IMF and IDA constitutes a significant majority of the assistance provided. MDRI came into effect January 5, 2006, and builds on HIPC to provide full debt relief for eligible countries from the IMF, IDA, and the AfDF. Timing and procedures for MDRI relief vary by institution and recipient country, e.g., some countries started IMF relief in early 2006, while World Bank assistance does not take effect until July 1, 2006. Of current HIPC countries, only those at completion point are eligible for MDRI relief.*
3. *Calculations made assume 2003 consumption levels are representative of levels in 2002 and 2006.*
4. *Cost of oil to country in 2002 is calculated using CIA World Factbook figures for estimated 2003 country consumption levels and the average of 2002 weekly crude oil prices provided by the Energy Information Administration of the Department of Energy, or $23.47/bbl in 2002 dollars. Inflation since 2002 is assumed to be negligible.*
5. *Projected world price for 2006, $59.76/bbl in 2006 dollars, is the average of 2006 weekly world crude oil prices as of June 1, 2006, as provided by the Energy Information Administration.*
6. *Increase in cost of oil from 2002 to 2006 denotes a 155% increase.*
7. *Calculations made assume 2005 GDP levels to be representative of levels in 2006.*
8. *What is considered "Poverty Reduction Expenditure" varies according to country, but primarily includes public spending on education and health. It may also include rural infrastructure, water works, roads, HIV, social safety nets, and agricultural research.*

Sources: CIA World Factbook; Bureau of African Affairs, U.S. Department of State; Energy Sector Management Assistance Program and International Development Association, The World Bank; International Monetary Fund; Energy Information Administration, U.S. Department of Energy; United Nations Development Program.

Bioenergy and biofuels offer developing countries an opportunity to leapfrog the developed world's oil dependence, avoid overreliance on dirty coal production, and reduce energy costs while reducing greenhouse gas emissions. Importantly, a significant increase in commercial-scale biofuel production must also be accompanied by technological gains to improve efficiency and productivity in overall production processes and to increase yields of both food and energy crops.

As each nation grapples with the economic, social, and national security consequences of our collective global dependence on oil, the impact of global warming on agriculture productivity and the health of people and the planet is potentially staggering. The overwhelming scientific consensus suggests that the earth's temperature is rising due to an increase in greenhouse gas emissions as a result of human activities, including the burning of fossil fuels. Unless we reduce the emissions of greenhouse gases, average global temperatures are predicted to rise two degrees F to 10 degrees F by the end of this century, while the risks of possibly irreversible climate change escalate with a global average temperature increase of approximately 3.5 degrees F.

Developing countries and the world's poor are likely to bear the brunt of the impact of global warming as they remain the most vulnerable populations to natural disasters, drought, and disease. In the agricultural sector, volatile weather patterns and unpredictable consequences of global warming exacerbate risks to small scale producers in every corner of the world. Agriculture production will be subject to higher average and peak temperatures, as well as the increased frequency and intensity of extreme weather events such as droughts, storms, floods, and heatwaves. Moreover, changes to rainfall patterns will lead to profound impacts on water availability and soil quality.

Recent studies suggest India and Africa are particularly vulnerable to human health and agricultural losses as a result of climate change. Both India and Africa are likely to experience a large increase in premature deaths and it is anticipated that Africa will be faced with ever-increasing outbreaks of malaria. Crop yields in sub-Saharan Africa are projected to fall by 20 percent in some scenarios and climate change-induced famine may displace more than 250 million people worldwide by 2050.

United States Farm Policy

In the United States, we have an opportunity to craft a farm policy that rewards more of our farmers while contributing to efforts to combat global warming and global poverty. Converting $5.2 billion per year in current direct payments to American farmers into a new green payment program would provide a consistent source of revenue for many more farmers than the current commodity-based program. All eligible farmers would be rewarded for providing measurable environmental services on their land, including carbon sequestration, soil conservation, and preservation of wildlife habitat.

In an open and transparent program, with clear standards for environmental improvement, farmers would be able to incorporate the environmental, agricultural, and low carbon benefits of growing dedicated energy crops into the green payment program. Current recipients of direct payments would be eligible for the green payment program and may be working land ideally suited to growing dedicated energy crops. The new program would include a significant transitional adjustment period during its phased-in establishment for farmers currently receiving direct payments.

In the initial stages of the program, farmers would be eligible on a temporary basis to receive both green payments and the revenue from the harvest of dedicated energy crops. This provision would be phased out if dedicated energy crop feedstock prices reached a targeted price level established by statute.

In contrast to current commodity-based direct payment programs, all farmers would be eligible for green payments. At present, existing commodity programs do not apply to over 61 percent of U.S. farms.[26] The practice within the current system of paying non-farming landowners—with some

Table 2—U.S. Subsidy Payments as Share of Cash Receipts, Average FY1996-FY2005

Commodity	Subsidy as Share of Cash Receipts	Commodity	Subsidy as Share of Cash Receipts
Rice	72%	Sunflower Seed	21%
Upland Cotton	58%	Canola	20%
Sorghum	45%	Flaxseed	13%
Wheat	34%	Dry Peas	12%
Barley	30%	Peanuts	11%
Corn	25%	Soybeans	10%
Oats	25%		

Source: Subsidies include commodity support payments and crop insurance indemnity payments in excess of farmer-paid premiums. Calculations were made by CRS from USDA data. (See Randy Schnepf, Jasper Womach, Potential Challenges to U.S. Farm Subsidies in the WTO: A Brief Overview, Congressional Research Service (CRS) (October 25, 2006) 3, 5.)

Table 3—U.S. Commodity Subsidy Outlays, by Program, FY2002-FY2007F

Program	FY02	FY03	FY04	FY05	FY06E	FY07F
			$ Million			
Direct Payments Program [a]	3,968	3,857	5,278	5,235	4,949	4,170
Counter-Cyclical Payments Program		1,743	809	2,772	3,975	3,147
Marketing Loan Program	5,987	4,752	1,047	5,608	5,693	402
Loan Deficiency Payments	5,345	693	461	3,856	4,576	351
Commodity Certificate Gains	0	3,869	268	1,520	1,106	32
Marketing Loan Gains	642	190	318	232	11	19
Milk Income Loss Contract	0	1,796	221	9	515	600
Cotton User Marketing Program	182	455	363	582	312	0
Total CCC Commodity Payments	16,124	17,355	8,765	19,814	21,137	8,721
Dairy price support program	622	698	74	(30)	88	145
Sugar price support program	(130)	(84)	61	(86)	0	0
Total Commodity Purchase Operations	614	135	(116)	88	145	
Crop Insurance Indemnities in Excess of Farmer-Paid Premiums [b]	1,772	2,892	1,871	1,500	750	na
Total Commodity-Specific Support	18,388	20,861	10,771	21,198	21,975	8,866

Source: Data are from USDA, FSA, CCC Net Outlays by Commodity and Function, July 11, 2006. Outlays for FY2006 and FY2007 are budget forecasts.

[a] Direct payment outlays for FY2002 include funds for the predecessor contract payments program.

[b] There are additional federal costs for crop insurance delivery and administration not included in these calculations. However, those costs benefit the providers and not directly the farmers. (See Randy Schnepf, Jasper Womach, Potential Challenges to U.S. Farm Subsidies in the WTO: A Brief Overview, Congressional Research Service (CRS) (October 25, 2006) 3, 5.)

estimates suggesting the federal government has paid at least $1.3 billion in subsidies for rice and other crops since 2000 to individuals who do no farming at all—would be curtailed.[27] Similarly, the inflation of land values as a result of commodity-based direct payments that are a particular barrier to small farm operators or young, new farmers who rent land in order to farm would be reduced.

Significantly, in order for farmers planting dedicated energy crops to qualify for green payments, the environmental and conservation gains associated with their energy crops must be performance-based, measurable, and demonstrate continuous improvement. For example, land incorporating dedicated energy crops into its mix of environmental services might need to show improvement in such areas as soil quality, soil erosion reductions, carbon sequestration, water quality, water use, care of marginal lands, biodiversity, habitat preservation, and reductions in soil erosion and water use in order to be eligible for green payments.

While Congress can and should take these steps, they must also be accompanied by actions taken on the international trade front to ensure that increased U.S. negotiating flexibility is met by meaningful agricultural reform by our trading partners.

The WTO Doha Round

At the international level, a commitment to a global market in biofuels provides the United States with an opportunity to reinvest a portion of its resources away from less competitive commodity subsidies that result in low prices for farmers in the United States as well as farmers in vulnerable developing countries struggling to compete in a global economy. Agriculture is the sector of the global economy with the highest remaining trade barriers and distortions and the most to gain from further trade liberalization.

The inability of the United States, European Union, Japan, and other rich nations to substantially reduce a total of $292 billion a year in agricultural subsidies and high tariffs—amounting to 29 percent of overall farm income—and their unwillingness to grant greater market access to their markets for poorer country agricultural products have created a significant rift between the world's rich and poor countries. The upshot: The Doha Round of global trade negotiations are in disarray.[28]

While the ultimate fate and lasting impact of the Doha Round will hinge on achieving a broad package of trade reform in all areas—agriculture, services, industrial goods, capacity-building assistance—success in the agricultural negotiations is important for U.S. farmers and for the world. Agriculture remains the major stumbling block in the Doha Round, a problem with important implications for American farmers. In 2005, U.S. farmers exported $62 billion in agricultural produce. In the future, our farmers may come to rely on overseas markets even more, given that 95 percent of humanity lives outside of the United States.

In developing countries, the impact of a successful Doha Round will be modest and should not be overstated. Nonetheless, tariffs (and tariff rate quotas), particularly in Japan and the EU, account for 80 percent to 90 percent of the total costs of agricultural trade and are highly trade distorting.[29] The elimination of tariffs and other protective barriers globally would inject $16 billion annually into the economies of several developing countries and open key markets for American farmers.[30]

The result would provide a modest foundation for poverty reduction, improve the competitiveness of U.S. agriculture, and strengthen the multilateral trading system. But as farmers here and abroad diversify their crops to include dedicated energy crops, production levels of traditional commodities will be reduced and traditional commodities will increasingly deliver better prices and be more competitive in global markets.

While subsidies with a greater impact on production will also need to be addressed, the reform of direct payment subsidies will have a modest impact on reducing the overproduction and dumping of agricultural commodities on global markets and minimizing the accompanying weak prices for all producers. As prices increase, the United States, European Union, and other developed countries will have greater flexibility to meet the request of developing countries in the WTO Doha Round to improve their commitments to subsidy and tariff reduction.

Are Current Incentives for Biofuels in U.S. Farm Policy at Risk?

At present, incentives and support for biofuels in current U.S. farm policy are at moderate risk of being declared inconsistent with World Trade Organization obligations. In order to be deemed permissible under WTO rules, a farm program must not allow direct payments to farmers that are related in any way to price support and production of specific products.

In the past, subsidies have been allowed for direct payments to bolster farmers' income based on historical use of acreage and regardless of whether or not the farm is in production. Additional examples of permissible subsidies have been payments for environmental, conservation, and rural development programs, as well as research and development. Nonetheless, if support payments for dedicated energy crops are too closely and directly tied to production of dedicated energy crops, the program may have difficulty qualifying as a permissible subsidy.

Farm support programs such as the 2002 Farm Bill's Bioenergy Program, which encourages production of biofuels via payments to producers based on the number of gallons they produce, are tied to production and therefore may be deemed impermissible subsidies. In addition, the current 54 cent-per-gallon tariff the U.S. applies to imported ethanol is likely to be deemed inconsistent with U.S. trade obligations because it discriminates against foreign producers.

And yet, due to the relatively immature nature of the global trade in biofuels, the Bioenergy Program, and other direct payment programs, biofuel production support programs may be acceptable, particularly if they are directed at the production of cellulosic ethanol. If the cellulosic biofuel is produced from feedstocks not routinely commercially traded as commodities, such as switchgrass, miscanthus, jatropha, and crop wastes, and the final product of cellulosic biofuel is not traded internationally, then it would appear less likely that a trading partner could mount a successful WTO challenge to the program.[31] As biofuels become a global commodity and are increasingly traded in international markets, this position will be all the more difficult to defend.

Another approach to potentially insulate current and future U.S. farm policy incentives from WTO challenge is to place support payments for cellulosic biofuels and dedicated energy crops such as switchgrass into a low carbon green payment program incorporating energy crops that closely resemble existing and popular (but traditionally underfunded) environmental and conservation programs, including the Conservation Reserve Program and Conservation Security Program. Many farmers have successfully grown switchgrass on portions of the approximately 35 million acres of so-called CRP land in the U.S. while earning additional revenue income and saving the federal government the cost of additional payments on the land used by energy crops. (Conservation Reserve Program rental payments are currently $1.6 billion per year to land owners and operators).

Nonetheless, any further consideration of growing switchgrass on CRP land must be accompanied by a comprehensive survey of current CRP land to identify and determine acceptable CRP lands for dedicated energy crops. The reason: Congress needs to ensure the primary conservation goals of the program are not compromised.

The establishment of an environmentally beneficial green payment program incorporating energy crops offers the U.S. an important means of ensuring its farm-based incentives for cellulosic biofuels and other renewable energy incentives are eligible for permissible subsidies and are consistent with WTO rules (See Box, page 27). Direct payments that qualify for the WTO "Green Box" are eligible to receive relatively unlimited subsidies and are exempt from mandatory reductions.

By seizing the initiative now to design payments and programs to allow for permissible support, the U.S. can ensure its policies are minimally trade distorting and contribute to a functioning global market in biofuels while avoiding trade disputes at a later date. The result will provide a major boost to strengthening U.S. farm-based renewable energy efforts and the full commercialization of cellulosic biofuels. Equally important is the need for the Doha Round to craft rules that support, rather than hinder, the sustainable growth of a global biofuels market.

Biofuels at the WTO: Little Progress, Much Confusion

At present, the WTO has put forward an inconsistent approach to the liberalization of trade in biofuels, which may ultimately hinder the establishment of a well-functioning global market. For example, the two market-leading biofuels—ethanol and biodiesel—have received different tariff classifications and are subject to different rules within the WTO. At the WTO, ethanol has been classified as an "agricultural good" while biodiesel has been classified as an "industrial good." Trade barriers and domestic support in agriculture tend to be at much higher levels than in industrial goods, or in trade parlance, "non-agricultural market access."

As the elimination of trade barriers and domestic support for each product is closely tied to their respective classification in the agriculture or non-agricultural market access negotiations, these unnecessary distinctions may produce different levels and pace of liberalization for ethanol and biodiesel that will result in mixed and confusing signals to burgeoning markets in renewable energy. These classifications need to change.

In order to modernize the current WTO classifications for biofuels in a manner more consistent with the Doha Round's mandate in paragraph 31(iii) of the Doha Ministerial Declaration to "reduce or as appropriate eliminate tariffs and non-tariff barriers" on environmental goods and in recognition of the environmental attributes of renewable fuels, biofuels such as ethanol and biodiesel should be reclassified as environmental goods and services and made eligible for reductions in trade barriers on an expedited basis. To date, progress has been slow to non-existent in the Environmental Goods and Services negotiations under the auspices of paragraph 31(iii) as WTO member nations have been unable to reach consensus on an approach to or the classification of an environmental good.

The environmental attributes of biofuels and their potential to reduce greenhouse gases, prevent soil erosion on marginal lands, and conserve wildlife habitat, among other characteristics, make biofuels strong candidates for reclassification as environmental goods entitled to fewer trade restrictions. In general, accelerated tariff reduction and rapid liberalization of biofuels are likely to improve prices for consumers, increase investment in biofuel infrastructure, and enlarge the export market for biofuels

in developing countries. Increased liberalization in the trade in biofuels should also be accompanied by strong government and private sector incentives for advanced biofuels and technology transfers domestically and internationally.

In order to ensure the integrity of an environmental good classification at the WTO and to ensure biofuels are being produced in a sustainable manner, environmental performance criteria for biofuels should be established in an open and transparent international forum that is open and accessible to all developing countries. Capacity-building assistance should be provided to developing countries to enable their participation and dissemination of their expertise in biofuels.

The criteria or international standards established in this forum should be consistently reviewed and updated by all participating countries. The WTO should use the agreed upon international standards for guidance when determining whether biofuels qualify for treatment as environmental goods eligible for reductions in trade barriers on an expedited basis. Taking these steps would go a long way toward creating a sustainable global alternative energy marketplace.

Building a Global Market in Biofuels: Outreach to the EU and Brazil

The elements of this proposal will give the United States the negotiating flexibility to conduct outreach and find common ground with key trading partners such as the EU and Brazil to accomplish the twin goals of reforming existing agriculture and trade policies to move the Doha round forward and contribute to the establishment of a functioning global market for biofuels.

The European Union is a major promoter of biofuels as a means to reduce greenhouse gas emissions, diversify fuel supply sources, and bolster rural incomes. The EU is currently the world's largest producer of biodiesel and has established a target of making biofuels eight percent of the overall volume of European transportation fuels by 2015. Since 2003, the EU Common Agricultural Policy has provided a premium payment program to farmers to grow dedicated energy crops on traditional working lands.

At the same time, the EU's inability to reduce its high tariffs and trade-distorting support for European farmers has been one of the major roadblocks to progress in the WTO Doha Round. The U.S. and the EU have a common interest in both the promotion of biofuels and in efforts to support farmers and rural communities in a manner consistent with WTO rules. The use of green payments for dedicated energy crops is not only in line with current EU policy, it might also allow the U.S. and EU to support farmers in a manner that is less detrimental to small-scale producers in developing countries.

The U.S. and Brazil are responsible for over 70 percent of the world's current biofuel production. Brazil is a major global agricultural superpower and *de facto* leader of the G-20 developing country bloc of nations in the WTO Doha Round. As an international leader in biofuel production, Brazil has been enthusiastically promoting a global market for biofuels as a means to diversify the world's production of biofuels, counter the high costs of oil, and reinvigorate rural communities, particularly in developing countries. At the same time, any progress in the WTO Doha Round will need the support of the U.S. and Brazil.

The U.S. and Brazil have a mutual interest in laying the foundation for a global biofuels market. At present, international trade in biofuels is limited by tariffs and subsidies that act as trade barriers, a lack of international standards, and low levels of overall global biofuel production. The willingness of the U.S. to gradually phase down the import tariff and open our market to more imported biofuels sends an important signal to Brazil that the U.S. is willing to take a leadership role in the promotion of biofuels, trade, and development.

In addition, the U.S. and Brazil could join forces immediately to leverage funding, increase private investment, coordinate regulatory policy, and expedite the deployment of technology to spur biofuels development in numerous developing countries. For example, joint advocacy by the U.S. and Brazil for greater technical cooperation, capacity building, and innovative financing mechanisms (such as initial funding for the World Bank's Clean Energy and Development Investment Framework, U.S. Export-Import Bank focus on renewable technologies, global development bonds, and projects under the auspices of the Kyoto Protocol's Clean Development Mechanism) would provide welcome momentum to the rapid development of advanced biofuels and clean renewable energy on a global basis.

Clearly, concerted global action by trade negotiators and policymakers in individual countries at several levels will be required to strengthen the linkages and achieve long term reform of global energy, agricultural, environment, and trade policies. Nonetheless, at the domestic level, numerous steps can be taken immediately to expand the consumer availability and the use of biofuels and support the research and development required to help us transition to the next generation of biofuels. Specific policy suggestions for U.S. policymakers are clearly in order, to which we now turn.

Growing the Biofuels Market: Expanding Consumer Choice and Distribution

Biofuels enjoy significant public support in the United States as a means to reduce dependence on oil, support local economies, and contribute to reductions in greenhouse gas emissions. Regrettably, numerous unnecessary obstacles continue to impede access to both the fuels *and* to adequate information regarding the availability of these competitive choices in energy.

Progress continues to be hampered by a lack of retail presence and a lack of consumer awareness regarding biofuels and other products. These barriers can and must be removed immediately. In the United States, the federal government and the private sector must redouble their efforts to loosen our dependence on petroleum by expanding consumer choice in gaining access to alternative fuels and vehicles, and to information regarding biobased products.[32]

Recommendations

- **E85 fuel and fuel pumps.** E85 is a fuel blend of 85 percent ethanol and 15 percent gasoline that can be dispensed at service stations with minimal alterations to existing pump, storage, and transportation infrastructure. In today's marketplace, less than 1000 of the 180,000 fueling stations nationwide offer E85 fuel pumps. The United States must create requirements and strong incentives that move big oil companies from their current inaction and make E85 reliably available at filling stations by:
  - Ensuring that ethanol fuel pumps are built where there is demand, by creating a requirement that in any county in the nation where 10 percent of registered vehicles can run on flexible fuels, 10 percent of pumps must provide E85 fuel. Establishing an E85 retail presence at more than 2000 service stations (for owners and branders of more than 25 pumps) by next year and ensuring E85 pumps are at 50 percent of all stations nationwide by 2015.
  - Providing low interest loans and grants to ensure increased retail delivery of E85.
  - Providing incentives to facilitate the prompt development of technical standards to ensure Underwriters' Laboratory (UL) and other independent testers approve safe and reliable standards for E85 pumps that will be accepted in all jurisdictions.
  - Promoting the installation of new fuel pumps and distribution infrastructure by increasing the tax credit for installing new pumps to $50,000 in 2006 and creating incentives for early action with a $10,000 decline in the credit amount each year until 2010.
  - Maintaining high quality standards for E85 production by establishing an industry specification that ensures the quality of gasoline blended in E85 meets industry standards and does not contribute to performance problems with E85.

- **Flexible-Fuel Vehicles.** At present, there are approximately 4.5 million flexible-fuel vehicles, or FFVs on America's roads and the number is increasing. In the U.S., FFV vehicles are produced by automakers with slight modifications to their fuel systems to give the vehicle the dual capacity to operate on either gasoline or E85, and allow the driver a choice of fuel based on cost, origin, and quality every time they fill up. Recently, U.S. automakers have made significant commitments to increasing the number of FFVs on the road. U.S. car manufacturers should be building on this momentum and strengthening their competitive advantage and strong market share in FFVs.

  The United States should ensure auto companies offer a new generation of highly efficient, advanced technology vehicles by:

  - Requiring that all new passenger vehicles sold in the United States are flexible fuel vehicles capable of running on high percentage ethanol fuel blends by 2015 and starting immediately with a commitment to transform the civilian federal government fleet to flexible fuel and hybrid cars by 2010.
  - Encouraging automakers to redouble efforts to make FFV vehicles more fuel efficient and explore the feasibility of utilizing existing technologies, such as turbochargers, to offset the energy content difference between gasoline and renewable fuels.
  - Preserving critical U.S. auto industry jobs and giving consumers more options, by offering strong incentives for manufacturers to convert their assembly lines and retrain workers to produce the advanced engines and hybrid cars of the future. For example, loan guarantees and competitive grants to carmakers to ease conversion of manufacturing facilities and relief for legacy health care costs in exchange for producing more FFV and hybrid cars are powerful manufacturing incentives that should be pursued immediately.
  - Recognizing the strong public benefits of improved fuel economy and biofuels, advocate for a new "Carbon Alternative Fuel Equivalent"[33] to assess the "petroleum mileage" of current vehicles and strengthen tax incentives for consumers who purchase, and automakers who produce, more efficient and advanced cars such as FFVs while eliminating tax advantages for gas-guzzling cars as a means to protect consumer choice and to foster incentives to put clean cars on the road.
  - Encouraging automakers to raise consumer awareness regarding FFV vehicles by promptly and thoroughly informing all current owners of FFVs of the capacity of their existing cars to accept both unleaded gasoline and high percentage ethanol blends such as E85 fuel today.
  - Encouraging automakers and parts suppliers to dedicate additional resources to improving the fuel economy of FFV vehicles.

- **Empowering Consumers:** Raising consumer awareness and empowering consumer choice will send a strong signal to the market that Americans are interested in biofuels, bioproducts, and clean affordable energy alternatives. The United States should expand consumer choice and promote innovation within American industry by:
  - Creating a program for the certification and labeling of biofuels and bioproducts that recognizes their environmental attributes including oil displacement, carbon emission reductions, and other benefits. The success of the Energy Star program shows that consumers are willing and able to use their buying power to influence producers toward more sustainable practices.
  - Fully implementing and funding at $5 million the existing Farm Bill biobased purchasing program to use the government's purchasing power to increase market demand for biobased fuels and products. The federal government, which spends more than $230 billion annually on products and services and is a major consumer of transportation fuels, can be a major catalyst for change.
- **Research and Development:** In order to promote necessary advances in biofuels and biobased technology, the United States must seize every available opportunity to mobilize the federal government and the private sector to make a significant and long-term commitment to research and development and then the commercialization of biofuels and other products. Efforts are needed to combine promising advances in biotechnology, genetics, chemistry, and engineering toward the development of fully-functioning integrated biorefineries capable of producing biofuels and numerous other valuable co-products.[34]

  Utilizing modern genomics, crops will need to be developed with physical and chemical traits that optimize conversion to fuels and products. Biomass yields will need to be doubled. At the biorefinery, commercially viable processes will need to be developed that extract value-added chemicals from biomass, pretreat lignocellulosics to increase the accessibility of biomass to enzymes, and capture any valuable properties of waste products created in the process. Additional research and development is needed to ensure that farmers engaged in carbon sequestration and soil conservation through dedicated bioenergy crops and traditional acreage farming are rewarded for their efforts. At minimum, the United States must:

- Fully fund the Congressional authorizations for biofuels R&D in the Energy Policy Act of 2005. The Act authorizes over $1 billion in spending on R&D for biomass and hybrid vehicles in Fiscal Year 2007 alone.
- Fully fund and enhance the Farm Bill's Renewable Energy and Energy Efficiency Improvements program at $50 million (authorized level of $23 million), as opposed to the current level of $10 million.

- Fully fund and enhance the Department of Agriculture's Biomass Research and Development Program at $500 million (authorized level of $200 million) and restore and enhance the Bioenergy program funding at $300 million (authorized at $150 million) per fiscal year.
- Increase federal spending on R&D and commercialization on advanced cellulosic biobased fuels and products, including efforts to make cellulosic-related technology more cost-competitive and commercially available. Establish bioenergy research centers with $1 billion to:
  - successfully develop an organism that is capable of producing enzymes to break down cellulosic material and ferment the resulting sugars into cellulosic ethanol more efficiently.
  - develop drought-resistant dedicated energy crops that require less fertilizer and produce more energy per unit of energy, water, and land.
  - improve efficiency and reduce costs of biomass gasification and biomass co-firing technology.
- Encourage new investment in education at land grant universities and rural colleges to continue the development of a versatile and highly skilled rural workforce to become the innovation leaders of U.S. agriculture in such areas as biotechnology and renewable energy.
- Increase federal research spending dedicated to developing smaller-scale biorefineries and biofuel plants.

Conclusion

When Congress later this year takes up the 2007 Farm Bill and other legislation, its new leadership will have a unique opportunity to enlist more farmers in renewable energy and conservation, strengthen the links between large and small agricultural producers at home and abroad, and reach out to our key trading partners to make progress on global trade negotiations. In so doing, the new Congress can mobilize greater investment in innovation and the development of exciting new markets to help combat global warming and revitalize our historically strong commitment to the support of our farmers and rural communities.

With new, progressive farm legislation underpinning this historic push, the private and public sector must act together to strengthen our commitment to the next generation of advanced cellulosic biofuels, bolster long term demand with cleaner fuels and cleaner cars, and encourage greater investment in the research, development, and commercialization of new biofuel and biobased technologies. Acting together, Congress and the Bush administration must lay the groundwork for a new strategic vision of world trade that offers a constructive way forward in the Doha Round. The final agreement must expressly recognize the importance of linking economic growth and development—while taking advantage of opportunities in the alternative energy arena—in order to build a future that advances both development and trade together.

We as a nation must then act on our promise to rural communities in the United States and in the world's poorest nations. We must reward farmers for actions taken to combat climate change by supporting a comprehensive approach to trade and development that earns both the support of the American people and our important trading partners in the developing world.

Bold challenges require bold leadership. Global warming, global poverty, energy security, and global free trade are the moral challenges of our generation. Progress will require passionate vision and immediate action. The United States should be investing in the capacity of America's family farmers to lead our nation toward diversified domestic energy production, increased prosperity, and greater security. By leading, we can free ourselves and our friends in the developing world of the high costs of narrow and outdated energy and agricultural policies and build a better future for all. We must act now.

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