



# Environmental and Energy Study Institute

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## Biofuels in a Changing World

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**Abstract:** The twin drivers of oil security and climate change have pushed biofuels into the forefront of US national energy policy. The industry has grown rapidly, and at this point is based upon corn ethanol and soy biodiesel. A variety of policy proposals are before the US Congress in terms of major pending energy and agriculture legislation which would greatly advance the role of biofuels. At the same time concerns have been raised about the cost of such proposals, the sustainability of biofuel production, potential competition with food, animal feed and other crops as well as land use issues. Biofuels represent an important piece of the solution to the challenges of a world facing climate change and oil security concerns – but are not a silver bullet. Instead, they must be part of a ‘sustainable’ strategy that works in tandem with other policies that will allow us to address multiple issues to achieve multiple benefits at the same time. Key elements that must be addressed include diversification of feedstocks that are appropriate to given regions based upon local soil, precipitation, low inputs and climate conditions; encouragement of local ownership so that local economic activity is enhanced; and development of new technologies and biorefineries that will promote high efficiency and a low/no net carbon emission life cycle. Without addressing these issues carefully and thoughtfully – whether in the United States, Brazil or other countries moving forward on biofuels – we run the risk of jeopardizing public consensus for long-term support of biofuels as well as jeopardizing the long term environmentally sustainable economic development that is critical to the well-being of our societies and our planet. This is a critical time to make sure we ‘get it right’.

### Introduction

Climate change is the most serious challenge facing the world today. Evidence of existing climate change impacts is staggering and alarming new ramifications of global warming are reported weekly. While skepticism about the reality of climate change has waned, agreement on the policy approach, technologies of preference, and time frame are still very much in debate – with no clear consensus yet emerging. We are faced with a very dynamic and exciting opportunity for creating significant change. Energy, both as a security and (now more prominently) as a climate issue, is on top of the national policy agenda. Candidates for the US Presidency have outlined for voters what they plan to do to address climate change and energy (security and price). More than 500 US mayors have signed a Climate Protection Statement, and numerous Governors of both parties have taken strong leadership



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positions addressing climate change. As evidence of climate change builds, the pressure to become 'green' or sustainable has become a driving force not only in politics but in the economy. Multinational corporations and many others in the private sector, including many energy companies, have emerged as interested players in renewable energy and energy efficiency (RE/EE) technologies as a way to combat climate change and increase their bottom line. Biomass-to-energy technologies, such as biofuels, clearly have been recognized by the federal and many state governments, corporations and investors as a renewable energy technology that is a critical component of a climate change mitigation strategy.

Enjoying exponential growth, given the run up in world oil prices and the enactment of supportive policies on the state and federal level, the biofuel industry has made tremendous gains in the last few years. Even with little support by federal funding (especially compared to fossil fuels and nuclear energy), large venture capital investments, new leadership, increased acceptance from the environmental community, national security threats, and unstable energy markets sparked the US enthusiasm for biofuels. Corn ethanol illustrates the industry's ability to become a larger player in energy markets. Since 2000 ethanol production has increased more than 300 percent with 2006 production reaching 4.9 billion gallons. By 2009 ethanol production will expand by another 6 billion gallons as a result of the construction of 73 new and 8 expansion projects across the United States. Similarly, biodiesel has increased from 75 million gallons at the end of 2005 to a total capacity of 1.39 billion gallons from the investment of 148 companies. In essence, developing biofuels has the potential to increase production and respond to climate change, while also dealing with security, and economic development which will boost farmer income, create jobs in rural communities, diversify the nation's energy markets, and protect the environment, but only if produced through sustainable practices.

### **Sustainable Biofuels as a *Part* of the Climate Change Mitigation Strategy**

Not surprisingly, the caveat about 'sustainable practices' is the key to the increased production of biofuels, as well as an increased realization that a strategy that includes multiple technologies working together is needed to mitigate the impacts of climate change. Biofuels will be **ONE** part of this strategy, but so will increased vehicle fuel efficiency, "smart growth" practices (enabling more transit, biking and walking), conservation and a variety of other technologies. This means that no country should even try to replace gallon for gallon gasoline or diesel with a biofuel. This would be extremely wasteful. This concept of gallon for gallon replacement does little to reduce greenhouse gas emissions and, in fact, increases opposition to biofuel production. There already is a backlash against substantial increased production of biofuels. Concerns over fuel vs food (or feed) and ecosystem degradation are bolstered if the United States were to try to replace the 140 billion gallons of gasoline and 9 billion gallons of diesel used annually. Instead, a vision of integrated low-carbon sustainable biofuel production must be combined with other technologies to reduce the amount of transportation fuel needed for a long term solution to climate change.

Innovations in vehicle technologies will be vital to this multi-pronged approach to climate change mitigation. The transportation sector uses 68 percent of all US oil consumed and produces over one-quarter of US greenhouse gas emissions. Changing the way the nation's 136 million cars and 95.3 million light trucks and SUVs are powered will significantly reduce our dependence on foreign oil and cut greenhouse gas emissions while bringing much needed jobs to communities across the United States through production of biofuels. The US now imports 60 percent of its petroleum at a cost in 2006 of \$300 billion.



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While we have seen some strides in vehicle fuel efficiency, it is important to strive for much more energy efficient vehicles in every size class. In fact, introduction of flexible-fuel, plug-in hybrid vehicles (FF-PHEVs) – vehicles that could get well over 100 miles per gallon (mpg) of gasoline – has the potential to transform energy use in transportation in the near future. The average car trip in the United States is less than 20 miles, so a FF-PHEV battery could fuel many, if not most, car trips (at prevailing electricity rates, equivalent to about 75¢/gallon). The battery can be recharged during off-peak night hours, when 40 percent of electric utility capacity is underutilized. This technology can make clean, renewable wind energy more attractive to utilities by providing storage for wind generated power, since wind generally blows strongest at night, during traditionally low-demand times. Longer trips could use biofuels, creating the potential for 100-200 mpg of gasoline or more.

Nevertheless, whatever role biofuels play in climate change mitigation strategy overall, sustainability must be addressed. Some of the major issues that will influence biofuel production deal with some fundamental agriculture issues, including competition for land and natural resource conservation and protection. Competition for land is a complicated issue that stems from the perceived differences between growing crops for food, feed, fiber and now fuel (including thermal, liquid, and/or electricity). Unquestionably, the production of biofuels needs to be done in a way which enhances natural resources, including soils, water supply and native habitats. Adding biofuel feedstocks to the US agriculture portfolio should not be deemed to be in competition with the goals of sustainable agriculture. In fact, the opportunity for biofuel production to aid conservation efforts and environmental sustainability are much greater than compared with conventional agriculture and fossil fuel production and consumption.

Indeed, sustainable production of biofuel feedstocks means a transition to a more diverse agriculture portfolio integrated with energy crop production. Feedstock production should take a comprehensive approach and account for specific soil type, climate, precipitation, and required inputs, etc. within a certain region or location. Furthermore, economic models have to be created and tested to determine/predict feedstock availability and cost. The goal should be to help farmers and foresters know which feedstocks are most appropriate to grow where and with as few inputs as possible. This not only will provide greater resilience for the agriculture sector but should also mitigate economic risks for farmers. Equally important is the environmental and social stress of the large number of biofuel facilities that have developed in the last few years. Although this increase in production is good for displacing liquid petroleum fuels, there are unforeseen trade-offs taking place that need to be addressed. The impact of biomass facilities on air, greenhouse gas emissions, energy, and water quality/quantity needs must continue to be reduced through technology efficiency improvements. As the industry continues to grow, this kind of full life-cycle analysis will become the norm in performance standards for biofuels, especially considering many countries which have started to mandate reductions in greenhouse gas emissions.

Subsequently, protections must be put in place to discourage large scale production without providing incentives to small farmers, foresters and communities to become involved. The current energy industry is dominated by a select few that has already expressed interest in funding, owning and operating huge biorefineries. The opportunity exists for our farmers and foresters to play a larger role in owning facilities, allowing their local communities to receive the benefits of a higher value product further down the production chain. Until the current energy industry is on a level playing field, through monetizing the externalities of fossil fuels and the removal of tax subsidies to conventional fossil technologies, small farmers and those investing in biofuel technologies will need additional incentives to compete



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against the fossil fuel industry, including the 51 cent production incentive, (which is off set by the 54 cent tariff on imported ethanol).

A stable and well developed market for domestic biofuels is vital for the creation of sustainable and socially equitable biofuel production. Encouraging the growth of sustainable biomass feedstocks across the United States will diversify our agriculture portfolio, reducing the country's reliance on a set number of crops for economic stability. Rural communities which produce biomass for energy and products may be revitalized through fair market prices for their crops and through ownership of biorefineries. The United States has lost hundreds of thousands of manufacturing jobs in the past few decades. Biofuels can help propel the manufacturing economy for the 21<sup>st</sup> century in many of our states. Farmers can be at the forefront of an 'employment and energy' revolution; utilizing the commodities they grow, and even the waste streams they now must dispose of, in innovative new ways to produce power, transportation fuels, and a new generation of biobased products and chemicals. In addition, biofuels produced locally and used domestically, with the right market development and incentives, can be a way to reduce US pressure on international markets and possibly increase, not just domestically, but the worldwide price of agricultural products. This should be a plus for farmers in developing countries who have been hurt by the exports of cheap American agriculture commodities. By developing a number of new crops and markets, US agriculture and energy policy could reduce WTO challengeable federal subsidies while restoring federal coffers.

### **US Policy for Sustainable Biofuel Production**

A variety of tools will be needed to promote this vision of sustainable biofuel production as part of a long term climate change mitigation strategy. Technological and agronomical improvements to biofuel feedstock and conversion technologies, along with an acceptance of change toward these new practices is crucial. Policies must undertake and incentivize educating the public, research, rural economic development through local ownership, feedstock production, biorefinery and increased market and infrastructure development to support these changes.

With hurricanes, skyrocketing and volatile oil and natural gas prices, national security, and climate concerns, the atmosphere in the last few years in the United States, as well as in other countries, has turned out to be ripe for biofuel-related legislation to finally garner much broader attention and support. Members of the US Congress have introduced more than 260 bills with new programs and incentives to encourage biofuel and other renewable energy technologies since the beginning of this year. (In addition, at least seven major economy-wide climate bills have been introduced with more anticipated this fall.) The biofuel industry has seen success from a combination of policy tools including tax credits, grants and loans, and regulatory standards. To see continued sustainable growth in biofuels from our rural communities it is important to develop a system of incentives that address the above-mentioned concerns in the most complementary way. Farm, energy and climate bills currently working their way through the US Congress all address the issue of environmentally sustainable biofuel production.

To achieve a considerable reduction in US oil imports, to reduce greenhouse gas emissions and to catalyze rural economic development, the United States has to act as a nation to overcome barriers to acceptance of biofuel technologies. National efforts to build a railroad system across the United States, to win World War II and to go to the moon, were not done with minor investments or without national leadership around these goals. Similar efforts are necessary to move the United States toward national renewable energy goals thereby changing the way it uses energy. There is growing recognition that



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biofuels represent a critical and exciting piece of the transition away from fossil fuel dependence. However, there still is a tremendous lack of information about the real contribution that biofuels can make. A public education campaign on renewable energy technologies, specifically biomass technologies, is needed. The United States, through grants, is seeking to encourage greater education in the hard sciences and math, including biology, chemistry, physics and calculus in academic programs. Understanding science and gaining technical skills will help the upcoming workforce transition into this new biofuel industry. Indeed, policymakers have also realized the importance for individuals, communities and small businesses to keep/increase ownership of production and biorefineries. Due to increased recognition of the need for an appropriately skilled workforce, policies at the state and federal level are being directed toward a number of new skills including business development, financial planning, networking, technical training, etc., through the community college and university systems. Through US agriculture policy, rural development programs are being retooled to spur innovation and entrepreneurship, while also developing these skills.

Furthermore, tremendous breakthroughs have been made in biofuel technologies. These gains move the renewable energy industry closer to becoming a larger player in energy markets every day. But more needs to happen to continue to phase in these important technologies. Policy in the United States is being directed into these **key areas of research: sustainable production, social and economic impacts of production and technical applications including conversion of materials, harvesting and storage infrastructure**. The ability to produce biomass in a sustainable manner is essential to its success as a renewable resource for energy. Continued research needs to be carried out in four main areas, including: biomass assessments for potential on a regional basis; sustainable production practices; environmental impacts of biomass facility production; and carbon sequestration. Increased production of biomass for energy has happened extremely fast and needs to be assessed for social and economic sustainability. This industry is changing the face of our rural communities, and it is important to shape these changes in the most beneficial manner possible. A variety of sciences are needed to develop economically and environmentally sustainable energy. Work and innovation in biology and chemistry have been focused on petroleum and synthetic materials for generations. General scientific research needs to be refocused on organic natural processes. To the extent possible, care should be taken in the development of crops and other technical areas to preempt undesirable consequences, and new conversion technologies can be encouraged to achieve this.

Academic and research institutions are the lifeblood of establishing a sustainable biofuel industry in the United States. Research, demonstration and deployment needs to happen in the **public** domain so society can reap the benefits. Public institutions need to have a surge of new funding to galvanize farmers, foresters and rural communities' interests in a biofuel and biobased products industry. The benefits of these technologies have the ability to revitalize our rural communities only if those communities are working hand-in-hand with public institutions to move these new technologies forward. The US Congress is developing new programs and adapting older, established programs to encourage research at institutions, as well as public-private-partnerships with both small and large major companies to achieve these innovations.

Over the last several decades major changes in production agriculture and federal policies have created an environment enabling enormous concentration within the agriculture industry. Energy production has the opportunity to break this trend because it can, and must, be vastly different from conventional production of crops. **As the new bioenergy industry develops, unique policies need to be adopted to**



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**make sure its growth is environmentally sustainable as well as economically beneficial to rural communities.** It has been found that the economic contribution of farmer-owned ethanol plants to the local community is 56 percent more than an absentee-owned corporate plant.<sup>1</sup> Innovative incentives for small businesses, farmers and foresters to take advantage of the opportunities presented by bioenergy should be a priority of rural development. The US Congress, through the farm bill and other energy legislation, is identifying ways to provide incentives to local communities and small cities for the integration of bioenergy systems that not only create biofuels but also power those communities.

Although the United States has seen increasing attention and interest from investors paid to biofuels, most of this has been related to current technologies (corn-based ethanol and soy-based biodiesel). There is substantial potential to ramp up sustainable production of biofuels through new cutting-edge technologies. Loan guarantees and grant programs have been identified by US policymakers as a critical tools to mitigate risk for investors in new technologies like cellulosic biofuels for medium and small biorefineries. Companies interested in entering into US markets for biofuels and biobased chemicals are running up against huge financial barriers to implement near-term technologies to produce these products. In fact, we are aware of several companies that have developed their pilot plants and licensed their technology in other countries because the overall environment has been more favorable to them. The United States could very well lose new technologies to other countries, including EU nations, Japan as well as India and China – and be in the circumstance of having to ‘import’ or license those technologies back to the United States.

Moreover, and naturally, an important area of focus for US policymakers is in the development of sustainable biofuel feedstocks. The growth of energy crops is going to happen if there is a market for them. The transition to cellulosic energy crops from traditional row crops is a major priority for stakeholders and policymakers involved in this industry. Programs are being discussed that will incentivize this transition through pilot projects and research needed to bridge the time between when a farmer plants a crop for a biorefinery and when the crop is ready to be harvested or when a biorefinery exists to buy the crop. How and where these crops will be grown will determine how environmentally sustainable biofuel production can be. Existing conservation programs as well as the possibility of new conservation programs, are being suggested as opportunities to further the production of feedstocks (woody, herbaceous and grain-based) for energy production.

The expansion of a Renewable Fuel Standard (RFS) is unquestionably the most visible and vital policy the United States is pursuing. The RFS production target of 7.5 billion gallons by 2012 (enacted in 2005) needs to be expanded because the US will surpass this standard early, possibly within the next 18 months. Policymakers working with industry groups and other stakeholders are debating the best way to alter the current standard to target environmentally sustainable low-carbon biofuels. When President George W. Bush recommended that the RFS be changed to an ‘alternative’ fuel standard in his State of the Union Address in January, there was immediate concern that such a change would direct support toward non-renewable and non-sustainable fuels, such as coal-to-liquids. The US Senate in July passed a new Renewable Fuel Standard that calls for 36 billion gallons of renewable fuels by 2022, with a carve-out for 21 billion gallons of advanced fuels (any feedstock but corn starch). It includes several environmental protections, but not as many as some organizations wanted. This will be a major issue when the House and Senate conference their energy bills this fall. As the strategy to mitigate climate

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<sup>1</sup> Urbanchuk, John M. "Economic Impacts on the Farm Community of Cooperative Ownership of Ethanol Production." LECG LLC. Paper prepared for the National Corn Growers Association September 2006.



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change continues to evolve in the US Congress, some key policymakers are discussing the option of a Low Carbon Fuel Standard (LCFS), similar to what the State of California is developing. Questions remain around a LCFS, but if implemented appropriately, it would be a technology-neutral, performance-based regulation which would call for the full greenhouse gas emissions life-cycle analysis of all fuels and would encourage the least carbon intense fuel.

### Conclusion

Biofuels represent an important piece of the solution to the challenges of a world facing climate change and oil security concerns – but are not a silver bullet. Instead, they must be part of a ‘sustainable’ strategy that works in tandem with other policies that will allow us to address multiple issues to achieve multiple benefits at the same time. Policy must carefully be constructed to reduce backlash and unintended consequences. Key elements that must be addressed include diversification of feedstocks that are appropriate to given regions based upon local soil, precipitation, low inputs and climate conditions; encouragement of local ownership so that local economic activity is enhanced; and development of new technologies and biorefineries that will promote high efficiency and a low/no net carbon emission life cycle. Without addressing these issues carefully and thoughtfully – whether in the United States, Brazil or other countries moving forward on biofuels – we run the risk of jeopardizing public consensus for long-term support of biofuels as well as jeopardizing the long term environmentally sustainable economic development that is critical to the well-being of our societies and our planet. This is a critical time to make sure we ‘get it right’.

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