Developing an Advanced Biofuels Industry:

State Policy Options for Lean and Uncertain Times

Environmental and Energy Study Institute

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February 16, 2010

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The Environmental and Energy Study Institute (EESI) is a non-profit organization founded in 1984 by a bipartisan Congressional caucus dedicated to finding innovative environmental and energy solutions. EESI works to protect the climate and ensure a healthy, secure, and sustainable future for America through policymaker education, coalition building, and policy development in the areas of energy efficiency, renewable energy, agriculture, forestry, transportation, and urban planning.

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Executive Summary

The two years since this project was first proposed have been the most turbulent in U.S. economic history since the Great Depression. The prospects for the advanced biofuels industry rose high and fell hard with the economy. A year ago, with the bottom of the recession still months away, what would we have been able to recommend to state policymakers? Did the lessons we had learned observing the rapid development of the advanced biofuels industry prior to the recession have any relevance to realities faced by state policymakers in the depths of recession? Where was the industry, or the broader economy, heading, and what could state policymakers do about it?

At the end of 2009, the industry still has significant challenges before it, but there are many signs of progress that were not evident nine months ago. The federal government has expanded and accelerated its advanced biofuels initiatives, and, as the economy has stabilized, private investment in the biofuels industry is increasing. A number of advanced biofuel plants are on schedule to begin producing fuels in 2010 and 2011. However, the fiscal capacity of most state governments remains the worst that it has been in decades, limiting their capacity to expand financial incentives for developing local advanced biofuels industries.

The purpose of this project was to determine what incentives best support the commercialization of environmentally sustainable, low carbon, renewable biofuel technologies, to identify ways federal and state incentives can work together, and to determine how states can position themselves to help meet federal biofuels mandates.

Toward that end, in 2008, EESI convened an advisory committee of experts from across the country from academia, finance, industry, non-governmental organizations, trade associations, and federal, state, and regional government agencies. The committee provided guidance and input for the research through the summer of 2008. EESI also conducted literature reviews and interviews with state agency officials and other experts in the field. A first draft was circulated to the advisory committee in the fall of 2008 - as the economy began to tumble.

This final report builds upon our findings from 2008 and supplements them with observations from 2009 – as the economy began to stabilize. It tells the story of the past two years of political and economic turbulence as it has impacted the advanced biofuels industry and suggests ways that states can support the development of this vital industry from this point forward.

From this vantage point, we have seen a more favorable trend in the second half of 2009 and significant infusions of federal support, but also we find that the advanced biofuels industry is still sputtering due to a host of uncertainties that lie before it. Most feedstocks and conversion technologies for advanced biofuels are still in the process of research, development, and demonstration. Some feedstock and conversion systems are further along than others, but the much costlier and higher risk stage – commercialization – is still ahead for most. Further, the future markets for advanced biofuels and the federal regulatory environment remain uncertain, and thus, financing for the commercialization of advanced biofuels production often remains difficult to obtain. Even in times when credit markets are functioning, a new start up industry would have had difficulty finding sufficient financing to cross the "valley of death" between pilot projects and full-scale commercialization. However, with today's frozen credit markets, risk-averse lenders are even less willing to finance this kind of enterprise.

The federal government, with its capacity to effect change on a national, economy-wide scale, is in the strongest position to address these uncertainties and create an environment in which the industry can succeed. However, federal policies, so far, have had only mixed results, and the politics of biofuels at the national level are adding to uncertainty about the industry's future. State policy interventions can make a critical difference now.

Every state has a stake in the development of the advanced biofuels industry, and most states are already quite involved in promoting development of their own industries. Developing sustainable local industries to serve local markets can contribute importantly to a variety of state goals: economic development, job creation, rural development, energy security, environmental protection, and climate change mitigation. Every state has the potential to develop advanced biofuels using its own unique combination of natural and human resources. Because the development of appropriate, sustainable bioenergy feedstocks (and thus, conversion technologies) is shaped fundamentally by local geography, resources, and ecosystems, state governments can play (and are playing) a critical role guiding the development of the industry in a manner that also advances state priorities.

Although the economic crisis has severely eroded the fiscal environment for most states, many have nonetheless continued to develop and implement biofuels initiatives and incentives in 2009. The motivations and opportunities for developing state biofuels industries remain just as compelling in the depths of this economic recession as before, if not more so.

This report recommends the following state policy options for these lean and uncertain times:

- **Inventory bioenergy resources and markets, and develop a long range plan.** Assessments and planning help identify local opportunities, resources, capacities, competitive advantages, and priorities. These processes can engage diverse local stakeholders and build critical political support from the outset.
- **Develop sustainable feedstock production guidelines.** Biomass should be produced in ways that sustain ecosystems, enhance biological diversity, maintain healthy air and water quality, and complement food, feed, and fiber production. Developing sustainability guidelines can promote a long term, holistic, landscape level view. The process helps identify the most important local environmental, economic, and social values and helps avoid unintended harms. The process is also important for engaging local stakeholders and building local political support.
- **Research and develop locally appropriate feedstocks and conversion technologies.** One of the biggest R&D challenges facing the advanced biofuels industry today is to develop many different locally appropriate systems for growing, harvesting, transporting, storing, and converting feedstocks to biofuels. In forested areas, developing local markets for forestry residues can provide revenue to support much needed forest stewardship programs and additional income from logging activities, while providing inexpensive feedstock for local advanced biofuels industries.
- **Create easement programs for sustainable feedstock production.** This approach provides financial incentives to land owners to develop cellulosic feedstocks on marginal lands in ways that complement other local land use and environmental priorities.
- **Establish minimum renewable fuel standards.** This approach helps create stable local markets for locally produced biofuels. It is most effective for promoting local economic development when it is linked to local biofuel production goals.
- **Enact a low carbon fuel standard (LCFS).** An LCFS can also help create stable local markets for locally produced biofuels. It can be designed to be more technology neutral and allow greater flexibility for producers than volumetric mandates. This approach is best done at the national level or with other states.
- **Promote interagency cooperation.** Interagency cooperation can help accelerate and improve statewide planning and coordination. It can reduce delays, transaction costs, and regulatory uncertainty for the siting, construction, and operation of biorefineries.
- **Cooperate with other states.** Interstate cooperation can provide opportunities to pool resources and coordinate policies, influence larger markets, benefit from economies of scale, reduce cross-border leakage effects, and exert greater influence on federal policy.
- **Provide tax incentives for producers and retail distributors.** Tax incentives can help overcome high upfront costs for producers and retail distributors. They work

best when they are long term, transferable, and can be carried over to future years.

- **Leverage state resources to promote federal and private partnerships.** Relatively small amounts, wisely invested, can help leverage far greater investments from the federal government and private industry.

States have a critical role to play in addressing energy, economic, and environmental security concerns and helping develop sustainable advanced biofuels industries. States can help fill the gaps, address the many uncertainties facing the industry, and provide leadership beyond federal policies. They are key stakeholders in this national policy initiative, with rich, diverse natural and human resources within their borders that can be brought to bear developing sustainable, local solutions to meet both local and national needs.

Biofuels Policies and Trends at the National Level

Before state policy options for the future can be considered, it is essential to understand some of the political and economic history of biofuels development at the national level. What has brought the industry to where it is today? What are the principal challenges ahead?

For the past few decades, the federal government has increasingly made the development of renewable biofuels a priority for advancing the nation's energy and economic security, and, more recently, for advancing environmental and climate security. In the 1980s and 1990s, the primary political reasons for developing domestic, renewable biofuels were to promote energy security and increase crop prices for farmers. However, the first big boost to the biofuels industry in the 2000s arose from efforts to protect urban air quality. Gasoline refiners were scrambling to find a substitute for methyl tertiary butyl ether (MTBE), a fuel additive that was used to help reduce smog from tailpipe emissions. MTBE was found to be posing a toxic threat to many urban water supplies. It was banned by several states. Corn ethanol was the most readily available substitute. Demand grew rapidly, more than doubling between 2002 and 2005, from 1.8 billion gallons per year to 3.8 billion gallons (U.S. Energy Information Administration (USEIA), 2009).

At the same time, public concern about increasing U.S. dependence oil imports grew in the aftermath of the attacks of September 11, 2001. Increasing production of domestic renewable fuels was proposed as a way to enhance national security and prevent future conflicts over oil. In the *Energy Policy Act of 2005* (EPACT) (P.L. 109-58) Congress enacted the first Renewable Fuel Standard (RFS), mandating further increases in renewable fuels production, and authorized other programs to increase biofuels production, distribution, and consumption.

The threat of global climate change was also of growing national concern. Many in the environmental community came to believe that substituting low carbon, next generation, cellulosic biofuels for petroleum based fuels could help mitigate climate change. Building the market and infrastructure for first generation corn ethanol could create the necessary bridge to the more environmentally benign and climate-friendly, next generation biofuels, which were still being developed.

Thus, a political convergence developed by the end of 2007 -- one policy to address three compelling public concerns: energy security, economic development, and climate change mitigation. These priorities were codified in the second Renewable

Fuel Standard (RFS2) in the *Energy Independence and Security Act of 2007* (EISA) (P.L. 110-140) and in the *Food, Conservation, and Energy Act of 2008* (farm bill) (P.L. 110-246).

The EISA dramatically accelerated and increased the Renewable Fuel Standard. The RFS2 required increasing renewable biofuels production from nine billion gallons in 2008 to 36 billion gallons by 2022. Of this, up to 15 billion gallons may be conventional ethanol made from corn starch; one billion gallons must be biomass-based diesel; and, the remainder must be "advanced biofuels" of which a minimum of 16 billion gallons must be made from cellulosic materials.

Biomass-based diesel can be made from plant oils, algae, animal fats, and leftover cooking oil. Advanced "cellulosic" biofuels are alcohol or other fuels made from renewable biomass feedstocks such as perennial grasses, corn stover and other agricultural residues, woody biomass, and yard waste which contain cellulose, hemicellulose, or lignin. Other advanced biofuels may be made from sugar, starch (other than corn), algae, or gas from landfills and sewage treatment plants.

The RFS2 also set lifecycle greenhouse gas (GHG) emissions limits on future renewable fuels. To qualify as an eligible fuel under the mandate, new corn ethanol production plants must reduce lifecycle GHG emissions at least 20 percent below the 2005 baseline for gasoline; advanced cellulosic biofuel must be at least 60 percent less; and biomass-based diesel and other advanced biofuels must be at least 50 percent less. Existing corn ethanol production plants were grandfathered in with respect to lifecycle GHG emissions.

In the 2008 farm bill, the energy title authorized and expanded a number of biofuels programs and provided significant mandatory funding to support biofuels research and development, the development of advanced biorefineries, and the development of new feedstock production supply chains. It also provided a tax credit of up to $1.01 per gallon for cellulosic biofuel production, including the extension of the volumetric ethanol excise tax credit for fuel blenders at a (reduced) rate of $0.45 per gallon.

Not all renewable biomass produced in the United States is eligible to fulfill the mandate. The RFS2 excludes woody biomass from most federal lands -- approximately one third of the nation's forests. It excludes much of the woody biomass that could be produced from privately owned forests. Also ineligible are the large amount of biogenic material in construction and demolition debris and the biogenic material remaining in municipal solid waste (MSW) after the eligible food and yard wastes have been separated out.

U.S. corn ethanol demand continued to soar, more than doubling again to 7.8 billion gallons in 2008 (USEIA, 2009). Ethanol production had grown to comprise seven percent of the U.S. gasoline supply in 2008, up from only one percent in 2000 (U.S. Department of Agriculture (USDA), Economic Research Service (ERS), 2009).

For further overview of federal biofuel policies and challenges, see U.S. Government Accountability Office (USGAO), *Biofuels: Potential Effects and Challenges of Required Increases in Production and Use* (USGAO, 2009).

The political convergence behind biofuels did not last long, however. Corn ethanol had been unpopular from the start in many states. Critics questioned the environmental, energy, and climate benefits of corn ethanol. Its production can be relatively resource intensive, requiring large amounts of land, water, and fossil fuel inputs, and it can produce significant amounts of greenhouse gases (GHG) and other environmental harm. Critics charged that the potential lifecycle GHG emissions from corn ethanol and soy biodiesel production due to indirect land use change made these biofuels more harmful to the climate than petroleum. They argued that the indirect effect on global corn and soybean markets of conventional biofuels production in the United States was causing the destruction of rain forests elsewhere in the world. Although the effects of U.S. biofuels production cannot at present be proven or quantified scientifically, critics argued that agricultural producers overseas were responding to higher global grain prices by opening more new land to agricultural production (Searchinger, et al, 2008; Fargione, et al, 2008).

For many environmental groups, political support for biofuels became contingent upon setting tight limits on the kinds of biomass feedstocks that could be used in the future, restricting the types of land that could be used, and sharply reducing the carbon intensity of next generation biofuels. These concerns were reflected in the restrictions that Congress imposed on biofuels in the RFS2 in December 2007.

Meanwhile, larger forces were at work in the broader global economy. Commodity prices were soaring. The price of petroleum hit $147 per barrel by mid-2008. Rising food prices were driven primarily by high petroleum and natural gas prices (key inputs to agricultural production). Other key factors included increased financial speculation, hoarding activities by governments around the world, weather-related crop failures in Australia and elsewhere, and rising demand for feed-intensive meat in China and India. The specter of hunger reared its head around the globe.

Biofuels and indirect land use change

The continued destruction of the world's forests is a major contributor to climate change, the loss of biological diversity, and many other critical environmental values. It needs to be addressed urgently and directly through international negotiations and the intervention of national governments. National governments are in the best position to protect forests and sensitive ecosystems within their borders, and they will do so when they have sufficient political will, resources, and capacities. Significant progress was made at the UN Conference on climate change in Copenhagen in December 2009 to provide the resources and develop the capacities to halt deforestation.

There are many diverse economic and social factors that drive deforestation and land use change in any given country. Rising domestic and global demand for food, fuel, fiber, and minerals, economic development, and urbanization are certainly among the leading factors. However, it is very difficult to discern exactly how much global market forces for any single commodity contribute to land use change. In the case of corn ethanol, scientists have yet to agree on a way to accurately estimate indirect lifecycle GHG emissions due to land use change in one country due to different types of biofuel production in another country. Nonetheless, in the RFS2, Congress directed the EPA to do just that.

In February 2010, the EPA issued its final rule for the RFS2. Based on new data and scientific assessments, the EPA significantly reduced its estimate of the life cycle GHG emissions from indirect land use change due to U.S. corn ethanol production compared to its earlier assessment. This will allow newer, more advanced corn ethanol plants to meet the 20 percent GHG reduction requirement. Nonetheless, despite the continuing scientific uncertainty, corn ethanol production still carries an emissions penalty based on EPA's indirect land use change assessment.

Continuing to penalize the U.S. corn ethanol industry in this way seems unlikely to have much impact on the rate of deforestation around the world, but it is likely to reduce the capacity of the United States to advance its energy, economic, and environmental security through continued improvement of its corn ethanol production systems.

How much U.S. corn ethanol production actually contributed to rising food prices is a matter of continued debate, but it was nonetheless effectively blamed by critics, such as the Grocery Manufacturers of America, for being the primary culprit. Many anti-hunger advocates and international development agencies, justifiably alarmed by the increase in global hunger, joined the food industry in condemning the biofuels

mandates in the United States and the European Union (EU) as a threat to global food security. The politics of "food versus fuel" gained political traction, further undermining public support for corn ethanol.

> The non-partisan Congressional Budget Office (CBO) estimated that the use of corn ethanol from 2007 to 2008 contributed a rather modest 10 to 15 percent of the total rise in the cost of food (CBO, 2009).

By mid-2008, the global credit and commodity price bubbles were popping. Wall Street investment banks began teetering. The U.S. and global economy plunged into the deepest recession in decades. Commodity prices plunged, as well. U.S. and global demand for liquid fuels shrank. Credit markets froze.

Many ethanol producers were caught out on a limb with long term corn supply contracts at too high a price, with too much debt, and with collapsing ethanol demand. The biodiesel industry was hit hard, as well. At the same time, in a trade dispute, the EU imposed stiff tariffs on U.S. biodiesel imports, essentially closing the door to U.S. producers who depended on Europe's far larger biodiesel market. Entering 2009, many biofuels plants shut their doors and declared bankruptcy.

By the fall of 2009, however, the corn ethanol industry began to rebound. Petroleum prices rose from below $40 per barrel to more than $70. Petroleum companies and other bargain hunters started buying and reopening shuttered ethanol plants. Valero suddenly became one of the biggest ethanol producers in the country. Other major oil companies such as Exxon announced significant new investments in advanced biofuels research and development. Poet announced it was moving ahead to secure financing to build an ethanol pipeline from South Dakota to New Jersey. The corn ethanol industry returned to profitability.

The Obama administration gave the advanced biofuels industry a boost, as well, accelerating research, development, demonstration, and deployment as part of its overall goal to promote renewable energy, create jobs, and reduce GHG emissions. Congress and the administration provided hundreds of millions of dollars in grants and loan guarantees for advanced biofuels development through the *American Recovery and Reinvestment Act of 2009* (ARRA) (P.L. 111-5) and through accelerated implementation of the 2008 farm bill energy programs. For example, in May, the Department of Energy (DOE) announced that almost $800 million of ARRA funds would be allocated to advanced biofuels programs. In addition, more than $300 million in ARRA funding was allocated through the DOE's Clean Cities Program to expand E85 refueling infrastructure (USDOE, EERE, 2009).

By 2010, ten cellulosic ethanol plants are expected to be online with a name plate capacity of about 35 million gallons per year. By 2011, another dozen plants may be online, adding another 125 million gallons per year in name plate production capacity (Ethanol Across America, 2009). Poet announced that it had reduced the cost of producing cellulosic ethanol from corn cobs to $2.35 per gallon at its pilot plant in South Dakota, down from $4.13 per gallon and approaching its $2.00 per gallon goal for commercialization (Poet, 2009). In December, fifteen major airlines announced an agreement with Rentech and AltAir biofuel producers to procure hundreds of millions of gallons of "drop-in" jet biofuel and biodiesel in the coming decade (Air Transport Association, 2009).

Yet despite the beginning of a rebound in 2009, the advanced biofuels industry is still sputtering and its future remains uncertain. The industry is not expected to come close to meeting the original 2010 RFS2 cellulosic fuel production mandate of 100 million gallons. (In February, the EPA reduced the mandate to 6.5 million gallons.) Biodiesel producers continue to struggle, producing at only about 15 percent of name plate capacity, with many plants still shuttered. The $1 per gallon biodiesel expired at the end of 2009. A study prepared for the National Biodiesel Board (NBB) predicts as many as 23,000 layoffs may be forthcoming as more plants are shuttered (Urbanchuk, 2009).

The availability of feedstocks and conversion technologies for advanced biofuels remains uncertain.

- Farmers and foresters are risk averse. They are hesitant to plant new crops, invest in new technologies, or shift to new production practices when the markets for biomass production are so uncertain. The biorefineries have not been built yet. Significant hurdles remain concerning how to sustainably produce, harvest, store and transport the massive amounts of biomass that advanced biofuel refineries will need.

- Without feedstock producers, advanced biofuel producers are unable to secure the long term, low cost feedstock contracts that they need to secure financing.

- Advanced biofuels producers still face significant technological hurdles to develop economically competitive energy conversion processes at the commercial scale. To be competitive, production costs need to come down well below $2 per gallon. Although corn ethanol is more or less competitive (depending on the price of oil), few other advanced biofuels are close yet.

- Feedstocks and conversion technologies for advanced biofuels vary greatly among different states, regions, and ecosystems. One feedstock and one conversion process will not necessarily fit all. Each state and region has its own

unique set of conditions to overcome on the path to commercializing its own feedstocks and conversion processes.

The market for advanced biofuels is uncertain.

- Global petroleum prices remain volatile. In 2008, prices plunged from a record high of more than $140 per barrel to below $40. The potential for future petroleum price volatility remains a threat to the commercial viability of advanced biofuels. Although much progress has been made to reduce the cost of producing advanced biofuels, most still cannot compete without substantial government subsidies or mandates at December 2009 petroleum prices ($70 to $75 per barrel).

- Many consumers are not sold on biofuels. Much more needs to be done to convince the public about the consumer value of using biofuels, to assure consumers that biofuels are safe to use in their vehicles, and to educate the public about the important energy security, economic development, and environmental benefits of using biofuels.

- Fuel distributors are hesitating to install expensive E85 and biodiesel fuel tanks and pumps, uncertain that it will be profitable. Relatively few vehicles on the road are equipped to use E85 so far, and there are relatively few gas stations that sell E85, biodiesel, or other advanced biofuels.

- Ethanol production is approaching a blend wall – market saturation at current fuel blending and consumption rates. The RFS2 mandates total biofuels production in 2010 of 13 billion gallons. Most of that will be ethanol. At the current E10 blend rate set by the EPA, with the increasing fuel efficiency of vehicles, and with the relatively small number of E85 fuel pumps and flex fuel vehicles on the road, ethanol market saturation is expected to occur by about 2012 at about 15-17 billion gallons of annual production. If nothing changes, there will not be a market for building additional ethanol production capacity of any kind – corn or cellulosic.

The federal regulatory environment is uncertain.

- The biofuels industry has asked the EPA to increase the ethanol blend ratio from ten percent to 15 percent so as to expand the market for biofuels and move the blend wall. Small engine manufacturers and boat owners are mounting strong opposition out of concern that it might harm engines and engine performance. Petroleum fuel distributors and auto manufacturers do not want to be held liable in the event that higher ethanol blend rates are found to damage engines. The EPA and DOE have so far found no evidence that a higher blend rate will harm

emissions control equipment or engines, but EPA has delayed its decision until mid-2010 in order to complete further testing with DOE.

- Many federal biofuels incentives – such as the $1 per gallon producer tax credit for biodiesel which expired at the end of 2009 – are enacted for only relatively short terms. Renewal is often uncertain politically. Short term policies like this do little to provide the long term certainty that investors and the biofuels industry need to make investment decisions that play out over a decade or more.

- In its definition of renewable biomass, the RFS2 excludes from eligibility most biomass feedstocks from federal lands, much of the woody biomass from private forests, and much of the biogenic matter in municipal solid waste and construction and demolition debris. This makes it difficult for many states to develop biofuels industries to their full potential. Congress is likely to revisit this in the months ahead.

- On Capitol Hill, the debate over the future of biofuels has widened, leading in 2009 to political brinksmanship over climate and energy legislation. Many members of Congress are calling for the RFS2 to be amended – to expand the definition of renewable biomass and to postpone for further study the issue of indirect land use change in the GHG lifecycle analysis of biofuels. After much debate, the House voted in June to delay for five years the implementation of the life cycle assessments of GHG emissions due to indirect land use change pending further study as part of its climate and energy bill (H.R. 2454). This debate is still ahead in the Senate.

As a consequence of these unresolved technological, economic, political, and regulatory issues, financing for advanced biofuels is uncertain. Even in times when credit markets are functioning properly, the advanced biofuels industry would have difficulty finding financing, with its unproven new technologies, undeveloped feedstock supply chains, uncertain markets, and uncertain regulatory future. However, with today's frozen credit markets, risk-averse lenders are even less willing to finance this kind of enterprise.

Reducing these uncertainties will be the critical challenge for the biofuels industry and state and federal governments in 2010 and beyond.

Advanced biofuels from corn starch?

The distinction Congress made in the RFS2 between ethanol made from corn starch and advanced biofuels is quickly becoming blurred. The corn ethanol industry has been evolving rapidly. For example, closed loop production systems have been developed which supply protein rich cattle feed, a co-product of corn ethanol production, to adjoining cattle feedlots and use biogas derived from cattle wastes to supply heat and power to the ethanol plant. This system has achieved reductions in direct lifecycle GHG emissions exceeding 60 percent below the 2005 baseline – well beyond the criteria for advanced biofuels in the RFS2. This innovation produces food, feed, and fuel with much less impact on the climate and the environment. Further advances such as these in both the agricultural and biofuels production systems promise even greater reductions in the land intensity, GHG intensity, water intensity, environmental impacts, and competition between feed, food, and fuel production (Liska, 2008).

Biofuels Policies and Trends at the State Level

Most state governments have recognized the important role that advanced biofuels can play in their future economic development. There are tremendous economic opportunities for every state in the future low carbon bioenergy and biotechnology economy. Energy security, environmental quality, and GHG emissions reductions can also be achieved along this path.

Every state has its own unique combination of natural resources, industrial capacities, economic infrastructure, research institutions, and skilled labor that can be developed to support a biofuels industry. Many states got started years ago and have developed a body of experience from which others can learn. By developing their own industries and policy experiences, and by joining with other states in their region, state policy makers are better able to inform and shape future federal policies.

The DOE's Alternative Fuels & Advanced Vehicles Data Center (AFDC) provides comprehensive, up-to-date, state-by-state information on state biofuels policies and resources (USDOE, AFDC, 2009).

Before the current economic crisis, states had much greater capacity to invest in developing their biofuels industries – supporting research and development and providing grants, loans, and loan guarantees. States were better able to extend tax preferences for producers, refiners and distributors.

Today, although the fiscal environment for most states is bleak, many states have nonetheless continued to develop advanced biofuels initiatives and incentives in 2009 (National Council of State Legislatures, 2009). Just in December 2009,

- The governor of **New Mexico** and state legislators convened the first meeting of a new initiative to develop a comprehensive statewide strategic biofuels plan. Dozens of experts from universities, federal research labs, agriculture, state agencies, and civic groups participated. Efforts will focus on developing dry-land feedstocks, such as camelina, and algae that can grow in New Mexico's brackish water and sunshine (Southwestern Biofuels Association, 2009);
- The **Louisiana** State University Agricultural Center announced the formation of the Louisiana Institute for Biofuels and Bioprocessing to develop a roadmap for the state's biofuels and biochemicals industry. Efforts will likely focus on developing feedstocks that do well in Louisiana's climate, such as bagasse, sweet sorghum, switchgrass, and algae (Louisiana State University, 2009);

- In **Kentucky**, the Executive Task Force on Biomass and Biofuels Production released its assessment of the state's challenges and opportunities to develop its bioenergy resources sustainably. The task force estimates that developing advanced bioenergy industries could create 10,000 jobs and generate additional revenue for the agriculture sector of $2.5 to $3.5 billion per year (Kentucky, 2009); and
- The **Texas** Bioenergy Policy Council, recently established by the state legislature, convened its first meeting to begin assessing the state of the bioenergy industry and its future potential and opportunities (Texas, 2009).

Creating jobs, attracting investment, adding value to local agriculture and forestry production, developing cutting edge biotechnology capacities, and building industries of the future remain common themes. The reasons for states to develop biofuels industries remain just as compelling in the depths of this recession, if not more so.

What follows are ten recommended advanced biofuel policy options for state policymakers to consider in these lean and uncertain times. Examples of initiatives from various states are provided, and federal programs are identified that can support states as they seek to develop their industries.

State Policy Options for Lean and Uncertain Times

1) Inventory bioenergy resources and markets, and develop a long range bioenergy plan.

Assessing a state's bioenergy resource base and developing an integrated, long-term bioenergy plan are critical first steps. These do not cost very much to do, yet they can pay big dividends over time. An inventory helps identify local opportunities, resources, existing capacities, and stakeholders. A good inventory and plan can help states focus limited resources to best effect. Developing a comprehensive plan provides an opportunity to engage with the many stakeholders – government agencies, agriculture and forestry, industry, research universities, and civic organizations - who will be needed to provide political and economic support.

The inventory should include potential biomass feedstocks, research and development capacities, associated industries, markets, and economic infrastructure. It is important to look at the economic and manufacturing infrastructure that is already in place – for example existing waste facilities, pulp and paper mills, rail capacity, and opportunities to use renewable biomass energy for combined heat and power. Human resources should be evaluated in areas such as agronomy, forestry, ecology, chemistry, logistics, business development, engineering, and project management.

The EPA and the National Renewable Energy Laboratory (NREL) have published a very helpful resource for states that are assessing and planning to develop their local bioenergy economy: *State Bioenergy Primer: Information and Resources for States on Issues, Opportunities, and Options for Advancing Bioenergy* (EPA and NREL, 2009).

Biofuels are just one of several options to consider in developing a comprehensive bioenergy strategy. An integrated bioenergy planning process can help a state identify ways to realize the greatest value (energy, economic, environmental) from its biomass resources. Given the many diverse and potentially profitable uses of biomass, states should consider developing integrated biorefineries that can produce multiple products (advanced biofuels, biobased industrial chemicals and products, heat, and power) for different markets and nearby facilities.

"California has large, untapped biomass resources that can be used as a source to produce energy… Using waste materials from the state's agricultural, forestry, and urban waste streams to produce energy may improve forest and animal health, reduces the risk of catastrophic wildfires, and reduces the volumes of landfill wastes. Biomass-based fuels should be pursued as one of the state's top priorities for achieving the Low-Carbon Fuel Standard, while ensuring that they do not degrade ecosystems." (California Air Resources Board and California Energy Commission, California State Alternative Fuels Plan, 2007)

In 2005, the **Washington** Department of Ecology worked with Washington State University (WSU) to analyze a wide variety of bioenergy sources county-by-county. The assessment focused on under-utilized material that could be converted to fuels, power, or products without disrupting other industries' supply chains (Frear, 2005). The inventory estimated that 16.9 million tons of dry renewable biomass would be available annually for the biobased economy – 49 percent from public and private forests, 35 percent from agriculture, and 24 percent from municipal organics (Washington State Bioenergy Team, 2007). The state then convened a "Bioenergy Team" comprised of representatives from the Departments of Agriculture, Ecology, Transportation, Community Trade and Economic Development, the Conservation Commission, WSU, and the USDA Rural Development Energy office. The group prepared a bioeconomy roadmap, developed a website for centralized information for industry, consumers, feedstock producers, etc., and made policy recommendations (Bioenergy Washington, 2008).

In 2006, **North Carolina** convened its first "biofuels summit", bringing together diverse stakeholders from across the state. In 2007, the state published "North Carolina's Strategic Plan for Biofuels Leadership," setting a goal of replacing ten percent of its annual fuel demand with biofuels made from locally produced energy crops and woody biomass by 2017. The plan was developed through extensive consultations with experts in agriculture, academia, industry, state agencies, civic groups, the North Carolina Biotechnology Center, and the Rural Economic Development Center. In 2007, the General Assembly created the Biofuels Center of North Carolina and provided $5 million for research and development in agronomics, conversion technologies, and workforce development. Energy crops - including miscanthus, switchgrass, sweet and grain sorghums, sugar beets, and fast-growing trees such as sweet gum and cottonwood – are being cultivated and tested at 20 sites across the state (Biofuels Center of North Carolina, 2009).

Urban and livestock waste streams offer significant potential to provide feedstock for advanced biofuels. Under the RFS2, advanced biofuels can be made from yard, food, and animal wastes, and gas from landfills and sewage treatment plants. These waste streams can be tapped at relatively low cost because the biomass feedstocks are already concentrated, waste collection infrastructure is already in place, and many local governments would be happy to avoid the landfill expenses and use land for better purposes. Converting these wastes to energy can also help protect local water and air qualityand eliminate a potent greenhouse gas – methane.

2) Develop sustainable feedstock production guidelines.

This is another relatively low cost, but critical element in developing a long term comprehensive plan. It too will pay off manifold for generations to come. The process helps identify critical environmental, economic, and social values that stakeholders seek to preserve, and it helps to avoid unintended harms. It also provides another key opportunity to engage diverse local stakeholders and build critical local support.

Biomass should be grown and harvested in ways that sustain ecosystems, protect biodiversity, maintain healthy air and soils, protect water quality and quantity, and complement the production of food, feed, and fiber. State governments and local stakeholders are in the best position to assess these dimensions at the local level and develop sustainability guidelines that are appropriate to their unique environment and natural resource base.

"Long term planning is an essential component of sustainable forest management, and management plans are one of the simplest and most effective tools for ensuring that management activities remain in line with management objectives. A good management plan is a valuable tool for helping to ensure that biomass harvesting complements other long-term stewardship objectives, such as stand improvement, timber management, habitat, biodiversity, and ecological restoration." (Caputo, 2009)

Forest management guidelines and programs to help implement the guidelines can ensure the environmental sustainability of forest ecosystems

while also promoting the use of woody biomass for advanced biofuels. State forest stewardship programs can provide tools and services to help private landowners create management plans to achieve the objectives prescribed within forest management regulations or guidelines.

The federal Forest Stewardship Program (FSP) can help state forestry agencies and private landowners create comprehensive forest stewardship plans. Since the program started in 1990, it has assisted in the creation of more than 300,000 management plans covering 35 million acres of private lands. However, there is still a long way to go. These management plans cover less than two percent of the lands identified by the FSP as high priority areas (Caputo, 2009). The program provides for technical, educational, and cost-share assistance based on the unique needs of each state and area of land to be managed (USDA, Forest Service, 2008(b)).

In 2009, the Council on Sustainable Biomass Production (CSBP), a national, multi-stakeholder organization, released for public comment a draft of its comprehensive, voluntary standards for the sustainable production of biomass and its conversion to bioenergy. The standards are intended to serve as the foundation for sustainable production and a certification program, which will engage all stakeholders in the process of guiding the emerging bioenergy industry. The CSBP standards will apply to biomass produced from dedicated fuel crops, crop residues, purpose-grown wood, forestry residues, and native vegetation. The standards address the full complement of sustainability issues, including climate change, biological diversity, water quality and quantity, soil quality, and socio-economic well-being (CSBP, 2009).

South Dakota's Forest Stewardship Program was established in 1990 to encourage active forest management, keep private forest lands healthy and productive, and increase the environmental and economic benefits derived from private forests. The program offers technical and financial assistance for private, non-industrial forest landowners to develop and implement a 'comprehensive forest stewardship plan for the forest landowner' (South Dakota Department of Agriculture, 2008).

The **Minnesota** State Legislature, in response to growing interest in using forest biomass for energy and fuels production, passed legislation requiring the Minnesota Forest Resources Council (MFRC) to develop guidelines for sustainably managed woody

biomass. The outcome of that process, *Sustaining Minnesota Forest Resources: Voluntary Site-Level Forest Management Guidelines for Landowners, Loggers and Resource Managers*, provides a good model (Minnesota Forest Resources Council, 2007).

In a similar manner, agriculture extension programs could be adapted to help agricultural feedstock producers develop sustainable production management plans while also adopting production practices that bring other environmental benefits. Through education, technology transfer, and financial incentives, these programs can increase the amount of biomass available for conversion to advanced biofuels by encouraging practices such as the planting of winter cover crops and utilization of animal manure – both of which could provide feedstock for biofuels, while advancing other environmental protection goals and complementing food and feed production.

Maryland's Agricultural Water Quality Cost-Share Program pays landowners to plant winter cover crops to reduce soil erosion and nutrient runoff into the Chesapeake Bay. Farmers receive up to $85 per acre for traditional cover crops that are not harvested but which may be grazed or chopped for livestock forage once they are well-established. Thirty dollars per acre is offered for commodity cover crops, which may be harvested (Maryland Department of Agriculture, 2008). This program could be adapted to allow harvesting for feedstock production while simultaneously increasing the amount of carbon sequestered in the soil.

Just to the south, Osage Bio Energy in **Virginia** is developing a biofuels production system based on this idea. In 2010, it plans to open a 60 million gallon per year ethanol plant using locally grown winter barley as the primary feedstock. The winter crop will help protect fragile watersheds by reducing winter soil erosion and nutrient run-off from hundreds of thousands of acres of otherwise barren fields. As part of a dual cropping system, the barley will provide farmers with additional income on top of what they would earn from normal summertime production of corn or soy. In addition, the process will produce a valuable co-product: a high quality livestock feed that can be used locally (Osage Bio Energy, 2009).

3) Research and develop locally appropriate feedstocks and conversion technologies.

The processes of inventorying state bioenergy production potential, developing strategic bioenergy plans, and formulating sustainable feedstock production guidelines will naturally lead to the identification of research and development (R&D) priorities. Scarce state funding resources can be used to greatest effect when they are used strategically to leverage matching funding from federal and private sources.

One of the biggest R&D challenges facing the advanced cellulosic biofuels industry today is to develop many different locally appropriate systems for growing, harvesting, transporting, storing, and converting feedstocks to biofuels. Many different feedstocks

and conversion technologies will be needed to meet the RFS2 mandates. Biofuels resources, feedstocks, and conversion technologies may vary within and between states.

The industry faces a "chicken or the egg" problem: feedstock producers will not produce feedstocks without assurance that biorefineries will buy their feedstocks, and biorefiners will not construct biorefineries without being assured of a large, low-cost, local supply of feedstock. Developing feedstock production and infrastructure sufficient to produce and handle the large amount of biomass material is thus a critical challenge.

States can help overcome this challenge by bringing together the many diverse stakeholders and facilitating the development of the complex production and supply chain, from developing and producing feedstocks, to developing feedstock infrastructure (harvest, transport, and storage), to developing conversion technologies appropriate to local feedstocks.

The federal government has set up a number of institutions that can help states and regions accelerate R&D for advanced biofuels:

- The Biomass Research and Development Initiative (BRDI) is a cooperative effort by the U.S. Departments of Energy and Agriculture to accelerate the commercialization of advanced biofuels and biobased products. BRDI provides strategic planning for advanced biofuel development at the national level, technical assistance and guidance to states and the industry, and funding for research, development, or demonstration projects (USDA and USDOE, BRDI, 2008a, 2008b).

- The 2008 farm bill reauthorized the Sun Grant Initiative, a national network of six regional research centers based at land-grant universities, supported by the U.S. Departments of Transportation, Energy and Agriculture. The Sun Grant centers provide competitive grants for research into feedstock production, agricultural diversification, and bioenergy technologies (Sun Grant Initiative, 2009).

- The USDA's Biomass Crop Assistance Program, administered by the Farm Service Agency, provides multi-year financial assistance to feedstock producers to encourage the production, collection, harvest, storage, and transport of bioenergy crops. By the end of 2009, the program had certified more than 280 biomass energy conversion facilities to receive biomass crops (USDA, FSA, 2009).

- Established in 2007 by the DOE's Office of Science, three Bioenergy Centers are playing a critical role advancing scientific research. The Wisconsin-based Great Lakes Bioenergy Research Center, the California-based Joint Bioenergy Institute, and the Tennessee-based Bioenergy Science Center each coordinate nationwide consortia of research universities and DOE research labs focusing on developing

next generation bioenergy crops, discovering and developing enzymes and microbes that can break down biomass, and developing new microbial methods for producing advanced biofuels (U.S. DOE, Office of Science, 2009).

In 2007, **Tennessee** committed $70 million over five years to the University of Tennessee Biofuels Initiative (UTBI) to develop a switchgrass-to-ethanol system. State leaders hope this will eventually lead to the creation of a commercial scale, low carbon biofuel industry, which the state anticipates could generate up to $400 million in new state and local taxes annually, 4,000 new jobs in rural counties, the production of one billion gallons of affordable, low carbon fuel, and additional benefits from satellite plants and biobased co-products (University of Tennessee Office of Bioenergy Programs, 2008). Subsequently, the UTBI received $135 million from the DOE with a goal to make cellulosic biofuel commercially viable by 2012 (National Association of State Energy Officials (NASEO), 2009).

The university is working with farmers to develop a home-grown switchgrass seed industry. A switchgrass incentive program has been initiated, whereby farmers are paid $450 per acre to produce the perennial feedstock in advance of a mature market (University of Tennessee Office of Bioenergy Programs, 2008). Collaborative research and development with farm equipment manufacturers is also ongoing. In all, more than 20 switchgrass R&D projects are being conducted in the areas of breeding, planting, management, harvesting, storage, transportation, and pre-processing. In addition, Oak Ridge National Laboratory (ORNL) received funding from the DOE to establish one of the three national Bioenergy Science Centers. This center is housed at the Joint Institute for Biological Sciences, a partnership between UT and ORNL. The Bioenergy Science Center moves the state one step closer to developing premier bioenergy and bioproducts research capabilities.

The **Oklahoma** legislature created the Oklahoma Bioenergy Center in 2007 to coordinate ongoing development of the state's bioenergy resources and agreed to provide $40 million to fund the multi-year initiative. The Center involves a collaboration between the University of Oklahoma, Oklahoma State University, and the Samuel Roberts Noble Foundation (Oklahoma, 2009). Developing biomass feedstock that can be grown on marginally productive land for biofuels has been a priority. In 2008, the initiative received a $15 million grant from the National Science Foundation to research the development of non-food crops for biofuels (NASEO, 2009). The findings of a multi-year study of various potential perennial grass feedstocks were recently released by researchers at Oklahoma State University. Switchgrass was found to be the most productive of the four species studied when harvested once per year and fertilized with 65 kilograms of nitrogen per hectare. The USDA sponsored the research (Haque, 2009).

In 2008, the **South Carolina** Bioenergy Research Collaborative was established between Clemson University, the DOE's Savannah River National Lab, South Carolina State University, and other private sector partners. The collaborative will research alternative feedstock production systems for crops such as sweet sorghum, switchgrass, pine, and

algae. With initial funding of $1.2 million from the DOE, the partnership plans to invest $14 million to build a pilot biofuels plant to develop methods to process South Carolina biomass (Clemson University, 2009).

In states with forests, pre-commercial thinning, habitat restoration, hazardous fuels reduction, logging, and other activities included in forest management plans are expensive operations. The low market value of the small-diameter trees and woody biomass, high transportation costs, and the lack of nearby markets have made it economically infeasible to do anything but burn the biomass in open fires or leave it to rot on the forest floor – practices that emit significant greenhouse gases.

The development of an advanced cellulosic biofuels industry can turn around the economics of forest management by creating local markets for slash and thinning material. Like other residue feedstocks, it takes little additional energy to produce because the residues are a byproduct of activities that already are occurring. Developing a market for forestry residues can provide revenue to support expanded forest stewardship programs and provide additional value for logging, while providing inexpensive feedstock for a renewable biofuels industry.

New York's Forest Utilization and Marketing Program was designed to address these challenges. The program primarily serves to facilitate a functioning market for the forest products industry. By supporting the market for woody biomass, the state improves the economics for working forests and all of their associated carbon cycle, watershed, wildlife, and other environmental benefits. The program releases stumpage price reports, timber harvest reports, and directories of companies that utilize forest products. It also provides management guidelines to ensure that forestry practices are conducted in a sustainable manner (New York Department of Environmental Conservation, 2008).

In **Oregon**, the Forest Biomass Working Group (FBWG), created by the Oregon Departments of Forestry and Energy, was established to increase the utilization of forest biomass for energy production and other wood products from federal, state and private lands. It focuses on using logging debris and material from forest thinning to reduce the risk of wild fire, accelerate tree growth, and increase resistance to disease and insect infestations. The FBWG is instituting best management practices as well as promoting the use of stewardship contracting authority on federal lands (State of Oregon, 2008).

4) Create land easement programs for sustainable feedstock production.

Like food production, forestry, and conservation, the decision to use biomass for the production of biofuels is ultimately a land use and economic decision no matter where the biomass is being produced. Easements can provide financial incentives to land owners to develop cellulosic feedstocks on marginal lands in ways that complement other local land use and environmental priorities.

An easement is a voluntary, legally binding agreement in which a private landowner allows the state government, land trust, or other entity to define the use of the land for a set period of time or in perpetuity, usually in return for a direct payment or tax break. States have used easements for a variety of purposes: to protect working farmland or forests, to conserve wildlife habitat, to preserve natural resources, to improve soil and water quality, to create hiker and biker trails, and to inhibit urban sprawl (Ohio State University, 2008; Land Trust Alliance, 2008).

Many easement programs define the use of the land for a combination of working land activities, such as agriculture and timber production, while requiring some level of protection of natural resources. The production of feedstocks for advanced biofuels could be yet another use for easements that could be compatible with other natural resource protection goals.

There are several different models of easements that could be adapted for low carbon biofuel feedstock production. The Bureau of Farmland Preservation in **Pennsylvania** established the Agricultural Conservation Easement Purchase Program in 1988 to slow the loss of prime farmland to non-agricultural uses. This program enrolls farmers voluntarily if they meet certain requirements such as minimum acreage, sales of agricultural products, and conservation management practices. Farmers receive easement payments in a lump sum or installments.

Pennsylvania's Clean and Green Program, which taxes land according to its use rather than the prevailing market value, also creates incentives for landowners to enroll in easement programs (The Nature Conservancy, 2008). This program preserves farmland, forest land, and open space on a voluntary basis if the owner meets program requirements. If land is removed from its permitted use, rollback taxes are imposed for up to seven years and an interest penalty is charged (Pennsylvania Department of Agriculture, 2008).

Both tax-based and payment easement programs in Pennsylvania could be used to grow low carbon biofuel feedstocks, allow for appropriate residue collection, and reduce land use conversion of important carbon sinks.

The Reinvest in **Minnesota** – Clean Energy Program (RIM-CE) established in 2007 was the first easement program created to target bioenergy crop production. RIM-CE charges the state's Board of Water and Soil Resources to acquire easements in targeted areas of the state for growing native perennial bioenergy crops for periods of at least 20 years. Selection of land would be based on its potential benefits for bioenergy crop production, water quality, soil health, reduction of chemical inputs, soil carbon storage, biodiversity, and wildlife habitat. The RIM-CE statute also provides for the designation of project areas. This ensures that land around projects is in a close proximity to support a sustainable supply of biomass without negatively impacting water quality or other natural resource goals. The clustered areas of native perennial bioenergy crops in the program are rewarded for their ability to enhance those goals.

The program is structured with a tiered payment system, whereby payment rates increase as more native perennial or woody species are planted to address specific local environmental benefits. The system is intended to reward public benefits created by specific management practices, such as reduced or eliminated tillage and erosion, reduced or eliminated use of fertilizers and pesticides, improved water filtration and infiltration, improved wildlife habitat, and increased storage of carbon in the soil (Board of Water and Soil Resources, 2008).

Easement programs should focus on forests and marginal and fallow lands where feedstock production goals can be integrated with other land use priorities such as increasing carbon sequestration and conservation management practices. The federal Forest Legacy Program (FLP) could be adapted for this purpose. This cooperative program with states and private land owners helps protect privately owned environmentally sensitive forests through conservation easements (USDA Forest Service, 2008(a)).

5) Establish minimum renewable fuel standards.

Setting state renewable fuel standards can help create stable local markets for locally produced biofuels. They are most effective for purposes of state economic development when they are linked to meeting local biofuel production goals. The costs of a renewable fuel standard are borne primarily by consumers, not state taxpayers.

As of December, 2009, 12 states had enacted their own renewable fuel standards or fuel mandates (U.S.DOE, AFDC, 2009). Examples include:

- In 2005, **Minnesota** enacted a biodiesel mandate. In 2009 the biodiesel blend rate was increased to five percent. It will increase to ten percent in 2012 and 20 percent in 2015 during seven (non-winter) months of the year.
- In 2008, **Pennsylvania** enacted legislation requiring up to ten percent ethanol in gasoline and up to 20 percent biodiesel in diesel fuel. The blend rate will increase as the state's biofuel production increases. It met its first biodiesel production goal in 2009, triggering a two percent biodiesel mandate which will enter into force in 2010.
- **Oregon** enacted its renewable fuel standard in 2007. It requires a ten percent ethanol blend with gasoline. In 2009, a two percent biodiesel mandate went into effect after the state's biodiesel production surpassed five million gallons. The biodiesel mandate will increase to five percent when production reaches 15 million gallons.
- Starting in 2011, **Massachusetts** will require diesel and home heating oil to include two percent biodiesel made from waste. The biofuel must meet a minimum requirement for lifecycle GHG emissions 50 percent below baseline. The state is

still evaluating whether biofuels made from other feedstocks will be able to meet that standard.

Another way that many states are helping to create stable markets for locally produced biofuels is by setting state minimum biofuel and flex-fuel vehicle procurement requirements for state vehicle fleets.

6) Enact a low carbon fuel standard.

The low carbon fuel standard (LCFS) is best for those states for which mitigating climate change is the top priority. It can be designed to be more technology neutral and to provide more flexibility for fuel producers than volumetric fuel mandates. Like the state RFS approach, the costs are primarily borne by consumers, not state taxpayers. This approach is best undertaken at a national level, or, barring that, in cooperation with other states.

An LCFS does not mandate the use of particular fuels or technologies in the way that a state RFS does, but instead it requires an average level of performance (i.e. carbon intensity) for transportation fuels and provides a variety of market based mechanisms for industry to use to achieve the standard. An LCFS can encourage investment in local feedstock and conversion technology research, development, demonstration, and commercialization.

California is perhaps the only state with sufficient market clout to enact its own LCFS. Governor Arnold Schwarzenegger signed an executive order in 2007 to create the state's LCFS. The LCFS is intended to reduce the carbon intensity of the state's transportation fuels by ten percent by 2020, reducing California's GHG emissions by an estimated 13 million metric tons per year. The executive order states that fuel refiners, blenders, producers, and importers shall be permitted to trade and bank credits for carbon reductions, thus adding market flexibility. The LCFS is intended to establish a stable environment for advanced, low carbon fuel investment by ensuring long term demand through regulation and a guaranteed market. The California Air Resources Board (CARB) spent 2008-2009 developing the implementing regulations (CARB, 2009). The LCFS enters into force in 2011.

California established complementary incentives with the **Alternative and Renewable Fuels and Vehicle Technology Program in 2007.** The program funds projects that develop and deploy low carbon fuel and vehicle technologies, as well as in-state fuel deployment. Preference is given to projects that are consistent with California's LCFS and provide economic benefits to the state. The program will invest $176 million in developing new low carbon fuels and vehicle technologies. Funding is provided in part through an increase in vehicle registration and smog abatement fees (California Energy Commission, 2009).

Many other states and regional bodies are now considering setting their own LCFS.

7) Promote interagency cooperation.

Interagency cooperation is a low cost way to help accelerate statewide planning and coordination for production systems that will come under the purview of many diverse state agencies and regulatory bodies. It can also help reduce transaction costs and regulatory uncertainty for the siting, construction, and operation of new biorefineries.

Commercialization of advanced biofuels is a complex endeavor and can have profound implications for local tax revenue, job creation, water, soil and air quality, public health, and energy security. A collaborative working group that draws on the knowledge and resources of various state agencies is an effective way to identify opportunities, barriers, and potentially conflicting objectives, and help each other solve problems.

A successful interagency collaborative might comprise representatives from the state departments of commerce or economic development, energy, transportation, agriculture, forestry, waste management, health, environment, ecology, and/or natural resources. Once established, interagency working groups can implement plans to efficiently move an industry forward. They offer states the ability to capitalize on the opportunities that an advanced biofuel industry can bring, while developing the industry in a way that is most useful for accomplishing a state's multiple and diverse goals.

Because advanced biorefineries are likely to use new technologies and will not necessarily fit into previously defined regulatory categories, an interagency group can be especially helpful to the industry by streamlining the permitting and approval process. To encourage projects scaled appropriately for local resources, these services should be available to large and small projects alike. Help for small businesses is key as they often do not have the resources to tackle large, complex regulatory hurdles that could consume time and resources. An interagency working group can also coordinate funding, provide technical assistance, and communicate programs, incentives, and other opportunities for businesses through a centralized website and other outreach efforts (Oregon State University, 2007).

South Carolina has established a Renewable Energy One-Stop Shop which involves collaboration by several state agencies, as well as other stakeholders. Renewable energy businesses use this program to set up just one appointment with all the appropriate agencies to gather information on state incentives and regulatory requirements and to expedite the permitting process (South Carolina Energy Office, 2008).

8) Cooperate with other states.

Regional cooperation can create economic and environmental benefits beyond what individual states can accomplish on their own. It provides opportunities for states to pool scarce resources and coordinate policies, to influence larger markets, to benefit from economies of scale, to reduce cross-border policy leakage effects (when policy goals are undermined when regulated entities, activities, or products are moved across the border to unregulated states), and to exert greater influence on federal policy.

Economic synergies can be developed between states. A recent study released by the Memphis Bioworks Foundation identifies significant economic potential for developing the bioeconomy in the five-state Mississippi delta region (Memphis Bioworks Foundation, 2009). The *Regional Strategy for Biobased Products in the Mississippi Delta* estimates that 25,000 jobs could be created over the next decade by collaboratively developing the region's biomass resources and existing infrastructure capacities. The *Northeast Regional Biofuels Action Plan* (Coleman, 2008) identifies similar economic opportunities and policy approaches for collaboratively developing the biofuels industry in the northeast.

Governors are recognizing the benefits of collective action on biofuels. The **Governors' Biofuels Coalition** (GBC) now has more than 30 members from states across the country. It is effectively weighing in at the national level on critical issues affecting the biofuels industry (Governors' Biofuels Coalition, 2009).

The **Midwest Governors' Association** (MGA) and the **Western Governors' Association** (WGA) both have established biofuels task forces that have been developing and coordinating regional biofuels policies. In *Midwestern Energy Security and Climate Stewardship Roadmap* (MGA, 2009), the MGA's Advisory Group recommends developing a regional low carbon fuel standard and jointly developing biomass feedstock demonstration projects.

The WGA established the Transportation Fuels Council in 2008 after adopting its policy resolution *Transportation Fuels for the West: A Roadmap for Energy Security and Improving the Environment and Economy*. The Council is charged with developing a framework to reduce GHG emissions through a performance-based standard, coordinate regional transportation fuels infrastructure and corridor development, assess potential impacts of energy choices on regional water supplies, and encourage uniform standards and regulations to promote product fungibility across state lines (WGA, 2009).

Alabama, **Tennessee**, **Kentucky**, and **Indiana** are cooperating in developing the I-65 Biofuel Corridor, making it possible for E85 and B20 biofuel users to travel from the Great

Lakes to the Gulf of Mexico and never be more than a quarter tank away from a refueling station (NASEO, 2009). Other biofuels corridors are being developed between **Washington**, **Oregon**, and **California**, and among Midwestern states.

An LCFS can be implemented with much greater effect and economic efficiency at a regional level than at the state level. Economies of scale can be achieved for alternative fuel and advanced biofuels producers, and the cross-border "leakage effect" can be mitigated more effectively. This also keeps regulations simpler for refiners who supply fuel to geographic regions rather than on a state-by-state basis, and it allows for product fungibility across state lines. Ultimately, this reduces the cost of the LCFS for consumers.

9) Provide tax incentives for producers and retail distributors.

Many states provide tax incentives for biofuel producers and for distributors to install biofuel pumps. Foregoing tax revenues may be more feasible than increasing direct spending in an uncertain economy. Tax incentives can be key to helping overcome high upfront costs for producers and retail distributors. Tax incentives can be targeted strategically toward specific barriers to biofuel production, helping the industry to make it over costly hurdles. Long term incentives are best for biofuels projects and investments with big up-front costs and long payback periods. They have added value when the benefits are transferable to third parties or can be carried over to future years. Performance standards based on GHG emissions screens or other environmental sustainability criteria can be built into tax incentives without picking technological winners, allowing a diversity of feedstocks and conversion technologies to compete.

South Carolina's *Energy Freedom and Rural Development Act*, enacted in June 2008, included a comprehensive package of incentives for the production of biofuels. To ensure funds stay in South Carolina, two incentives focus on diversifying feedstocks for biofuel facilities and research. One is a $0.30 per gallon production tax credit for biofuel facilities that use feedstocks other than corn and soy. This incentive gives priority to feedstocks that may be more regionally appropriate to South Carolina. (The state also has a $0.20 per gallon tax credit for the production of corn-based ethanol or soy-based biodiesel.) These production tax credits are 'bankable' for ten years, which means that funds from the tax credit are considered an income stream or a reduction in overall fixed costs. The other tax incentive is for research and development of feedstocks and processes for cellulosic ethanol and algae-derived biodiesel. This tax credit is an excellent way to encourage low carbon biofuels because it targets feedstocks that do not have to be transported long distances, reducing the full lifecycle greenhouse gases emissions of the final fuel (South Carolina Biomass Council, 2007).

Oregon has enacted a set of tax incentives targeting unique barriers and resources in the state. One incentive is a tax credit for the production and collection of biomass feedstock for both bioenergy (electricity and thermal) and biofuel production. Qualifying materials include used cooking oil or waste grease; woody biomass from nursery, orchard, agricultural, forest or rangeland property in Oregon; wastewater biosolids; yard debris and municipally generated food waste; animal manure or rendering offal; and crops grown for energy production (Oregon Department of Energy, 2007).

The USDA/DOE Integrated Biorefinery Demonstration Projects provides grants and loans for commercial scale integrated biorefineries – facilities that convert biomass into a variety of products including liquid transportation fuels, electricity, heat, chemicals, or other substitutes for petroleum-based products. In December 2009, the USDA and DOE announced the award of $546 million in grants to 19 biorefinery projects in 15 states. These grants matched $700 million in investments from private and state government sources (USDOE, 2009).

Oregon's tax credit makes it economically viable for logging residues to be taken out of the forest, instead of being piled and burned. Thus, GHG emissions are reduced on two fronts: by reducing the amount of low value material being burned in wildfires or open piles, and by replacing fossil fuels for energy production. This credit also helps create the infrastructure to collect, transport, and store feedstocks that otherwise would not have had a market value. Although this material is primarily being used for the biopower industry right now, Oregon will be ready to supply cellulosic feedstocks to biorefineries as they develop. In addition to the producer/collector credit, there is a credit for 'neat ethanol or pure bio-oils' producer, which was created to address the high cost of equipment (oil-seed crushers) to produce intermediary biofuel products. Both credits focus on areas of the biofuel production chain that are risky, especially if there is not an established market for those feedstocks or products.

The Business Energy Tax Credit (BETC) in **Oregon** was created to overcome the high up-front costs of renewable energy projects. Biorefinery projects and equipment used to produce biofuels are eligible for a tax credit (against taxes due) for 35-50 percent of the project costs. This is very helpful for producers working with cellulosic feedstocks such as woody biomass or grasses that are large, bulky, difficult to handle and costly to remove. The credit may be carried forward for a certain number of years, making this credit flexible for individuals who do not have a large enough tax liability to utilize the whole

credit in one year. Additionally, the 'pass-through' option gives the project owner the ability to transfer the tax credits to another eligible entity for a lump-sum of cash, allowing project owners who do not have a large tax liability to benefit from the tax credit (Oregon Department of Energy, 2008).

10) Leverage state resources to promote federal and private partnerships.

Most state budgets today are already over-stretched. However, for those states that are able, a relatively small amount of money, strategically invested, can bring big returns. Grant, loan, and loan guarantee programs can be particularly important in moving new technologies from demonstration to commercial scale production. New start-ups inevitably have trouble attracting the substantial investment that is needed to proceed to the next stage of development. State financing can also help to provide a certain measure of state control of a project's outcomes to assure that state goals (social, economic, environmental) are met.

In 2007, the state of **Tennessee** provided a grant of $40.7 million to DuPont Danisco Cellulosic Ethanol LLC (DDCE) to partner with the University of Tennessee to build a 250,000 gallon per year demonstration scale biorefinery. As of 2008, the partnership had leveraged more than $140 million to begin developing commercial scale biorefineries (DDCE, 2008).

South Carolina's SC Launch Program provides grants, loans, and equity investments of up to $200,000 for small business start-ups and up to $100,000 in matching grants for small businesses that have received support from the Federal Small Business Innovation Research Program or the Federal Small Business Technology Transfer Program (SCLaunch, 2009).

Since 2006, **Pennsylvania**'s Alternative Fuels Incentive Grant program has provided $17.8 million for 54 projects, leveraging $164 million by fuel distributors, public and private fleet operators, and the federal government. The state is also investing $5.3 million per year through 2011 to support in-state producers of biofuels – up to a cap of $1.9 million per producer (NASEO, 2009).

Florida's Farm-to-Fuel Grant Program, established by the 2007 state legislature, provides matching grants to bioenergy projects and received an appropriation of $22 million for commercialization projects and $3 million for research, development, or demonstration projects. The Farm-to-Fuel program gives preference to projects that are energy efficient and use Florida-grown biomass and innovative technologies. Several projects using a great variety of feedstocks, including forest waste, crop residues, municipal solid waste, animal waste, and algae, were awarded funding in 2008 (Florida Department of Agriculture and Consumer Services 2007, 3-4, 7).

As one example, Southeast Biofuels, LLC, was awarded $500,000 to build a commercial demonstration and pilot plant adjacent to a citrus juice facility that will convert citrus

peel waste into ethanol. The ultimate goal of this project is to build an eight million gallon per year biorefinery that will use 800,000 tons of citrus waste annually (Florida Department of Agriculture and Consumer Services, 2008). **Florida** generates enough citrus waste to produce about 60 million gallons of biofuel per year (Biopact, 2007). Although this quantity represents a small percentage of the state's transportation fuel needs, it is derived from a local feedstock that requires no extra land, water, or nutrient inputs or harvesting costs. By locating an appropriately scaled biorefinery adjacent to a citrus processing plant, feedstock transportation costs and emissions are essentially eliminated. Furthermore, utilization of this waste generates a revenue stream and avoids disposal costs and other environmental impacts.

Conclusions

The development of advanced biofuels is proceeding, thanks to strong federal and state policies. The technologies are advancing rapidly and the costs of production are coming down. The industry is poised to begin scaling up production in the next several years. But many impediments remain in the way. Federal and state governments will need to continue creating conditions for the industry to succeed for some time to come.

The federal government will continue to play the leading role in shifting the U.S. transportation system away from its dependence on petroleum toward low carbon, renewable, advanced biofuels. Federal policies and resources have been essential for helping state initiatives to advance and the advanced biofuels industry to develop. However, a national cookie cutter approach to developing advanced biofuels will not work, and, despite the significant level of federal involvement in promoting advanced biofuels, many hurdles remain.

States can help fill the gaps in federal policies and address many of the uncertainties facing the industry. States are key stakeholders in this national policy initiative, with rich, diverse natural and human resources within their borders that can be brought to bear in developing sustainable, local solutions to meet both state and national needs.

State policymakers have tremendous capacity to lead, innovate, and create, in ways that the federal government cannot. They know their landscapes, their ecosystems, their resources, their stakeholders, and their unique opportunities. They are better positioned to work with the many diverse local stakeholders on the ground to create a common vision for a sustainable, low carbon energy future. They can help drive the development of local advanced biofuel industries in partnership with local communities, the private sector, and the federal government, while steering that development in ways that meet the long term needs of local communities.

Finally, states can continue to fulfill their roles as policy incubators. The practical experiences developed at the state level in addressing pressing energy, economic, and environmental security concerns, and in developing local advanced biofuels industries, can feed back into the federal policymaking process, helping to shape more effective federal policies and contributing to better policy outcomes. States can help lead and push federal policy in new directions.

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Acknowledgements

Many hands assisted with this project. The Environmental and Energy Study Institute thanks the Energy Foundation for funding this project. We are grateful for the time and effort put forth by the Advisory Committee. Although the opinions and recommendations expressed in this paper are those of EESI, our Advisory Committee members provided invaluable input and guidance for this project. EESI staff Jetta Wong (EESI Policy Associate through fall 2008) and Laura Parsons (current EESI Communications Coordinator) organized and carried out this project in 2008 and prepared earlier drafts, and Ned Stowe continued the research in 2009 and pulled together this final report. Carol Werner, EESI Executive Director, provided guidance throughout the project.

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