Fulcrum BIOENERGY

November 10, 2009

Mr. Arthur N. Marin
Executive Director, NESCAUM
89 South Street, Suite 602
Boston, MA 02111

RE: Proposed Northeast/Mid-Atlantic Low Carbon Fuel Standard

Dear Mr. Marin:

Fulcrum BioEnergy, Inc. strongly supports the Northeast and Mid-Atlantic State's efforts to develop a framework for a regional low carbon fuel standard (LCFS), which will significantly reduce carbon emissions and our reliance on fossil energy sources.

Fulcrum is a privately held company with a mission to create a clean, low-cost and sustainable source of domestic transportation fuel. Unlike existing ethanol production methods from corn and other feedstocks, our approach relies on an abundant and renewable feedstock: municipal solid waste. Using a proven thermochemical process to convert municipal solid waste into ethanol, Fulcrum is leading the next generation of ethanol production. We are attaching a policy brief which describes more about our technology and the benefits of using MSW as a biofuel feedstock.

In the July 2009 NESCCAF report "Introducing a Low Carbon Fuel Standard in the Northeast," waste is identified as a large, local potential resource for both liquid fuels and electricity, and it is noted that "waste-based biomass does not raise the same concerns about indirect land use change caused by market-induced effects as virgin biomass feedstocks do." Consistent with Fulcrum's feedstock plans, the report focuses on the organic portion of the waste stream after "primary use and all economically and environmentally beneficial options for disposal, such as reuse or recycling, have been exhausted."

Since the Northeast and Mid Atlantic States already display strong leadership in recycling activities with some of the highest recycling rates in the U.S., the waste streams being landfilled in this region are an ecologically superior and economically attractive feedstock for low carbon biofuels. Waste materials that are recovered after recycling activities represent a large supply of untapped local energy potential that will help the Northeast and Mid Atlantic States achieve their LCFS targets.

fulcrum-bioenergy.com

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By converting the region’s waste streams through enhanced energy recovery technologies to bioenergy products, our facilities provide low carbon alternatives to petroleum-based fuels, contribute to local economies, increase fuel security and reliability, as well as achieve substantial reductions in the carbon intensity of transportation fuels. The development of these state-of-the-art technologies will support the growth of jobs, businesses and services in a clean energy economy in each of the 11 Northeast and Mid-Atlantic States.

Waste streams are an attractive feedstock because they have no direct or indirect land-use impacts. Further, they require no additional collection infrastructure and are abundant in every state in the region. NESCCAF found that nearly 60% of the available total solid biomass resource would be MSW under their “Likely Availability” scenario. Moreover, MSW and C&D waste streams offer those states with few natural biomass resources the ability to produce biofuels locally to displace their petroleum fuel demand.

The recent passage of the California Low Carbon Fuel Standard (“LCFS”), which sets strict greenhouse gas reduction goals for transportation fuel production, recognized that waste materials – including MSW and C&D – are a critical part of California’s ability to meet their regulatory obligations under the LCFS. In fact, the 18.3 million tons of MSW and C&D identified as available annually within California by the California Air Resources Board would produce enough low carbon biofuel to meet 15% of California’s transportation fuel demand.

We strongly support and encourage the Northeast and Mid-Atlantic State’s efforts to complete a Memorandum of Understanding by the end of 2009, and we offer our full support and cooperation as the process moves forward. We welcome the opportunity to participate in future stakeholder events by providing additional information about waste resources estimates, the commercialization of our innovative technologies, the anticipated local economic benefits of our projects, and the life cycle greenhouse gas benefits of the renewable biofuels and electricity we produce.

Thank you for your time and attention to this important issue.

Sincerely,

Ted M. Kniesche
VP Business Development
FULCRUM BIOENERGY, INC.

Enclosure: Waste Derived Bioenergy Policy Paper

Advancing Waste-Derived Biofuels As a Significant and Sustainable Low Carbon Fuel Pathway

A Policy Brief

Executive Summary

Post-recycled waste materials, such as municipal solid waste ("MSW") and construction and demolition waste ("C&D") represent one of the most environmentally and economically sustainable sources of biofuel feedstock available today. Large population centers are both the generator of large volumes of MSW and C&D and where a significant portion of transportation fuel is also consumed. Indeed, post-recycled waste can be efficiently converted to produce between 10-21 billion gallons of cellulosic ethanol annually. Moreover, waste-derived biofuels do not have the policy and environmental challenges that have plagued some conventional biofuels because waste feedstocks do not directly or indirectly impact land-use or food supplies, either in the U.S. or abroad.

By converting post-recycled MSW and C&D into biofuels, the U.S. can generate a significant portion of its transportation fuel from an abundant and domestically available feedstock at prices competitive with gasoline production. Post-recycled waste materials are a critical part of the biofuel future for the U.S.

Background

With the passage of the Energy Policy Act of 2005 ("EPAct"), Congress created a market for biofuels by mandating a Renewable Fuel Standard ("RFS-1"). The RFS-1 required, among other things, that at least 7.5 billion gallons of ethanol be blended into the Nation's transportation fuel by 2012. EPAct thus spurred the rapid development of the ethanol industry, which made its fuel primarily from corn. Today, approximately 11 billion gallons of ethanol are produced annually in the United States, according to the Renewable Fuels Association.

The Energy Independence and Security Act of 2007 ("EISA") further expanded the market for renewable fuels by increasing the RFS blending targets to 36 billion gallons of biofuel production by 2022. This new mandate, in an attempt to further spur advanced biofuels, required the new mandated volume to consist of 15 billion gallons of corn ethanol and soy biodiesel, as well as 21 billion gallons of Advanced and Cellulosic Biofuels that are made from non-food feedstocks and have more stringent greenhouse gas ("GHG") reduction requirements than conventional biofuels.

While dramatically expanding the renewable fuel mandates, EISA also addressed mounting criticism that biofuels as currently produced were not meeting the biofuel policy goals originally embodied by the legislation. In addition to reducing imports of foreign oil as a way of bolstering national security, policymakers also intended for biofuels to have strong environmental benefits that mitigate the effects of climate change. However, during the development and operation of corn ethanol projects in particular, a myriad of observers and critics called into question the real benefits of ethanol made from food crops such as corn.

Arguments against the industry pointed to studies that questioned the true GHG benefits of the fuel when taking into account the full lifecycle impacts associated with ethanol production. Questions about the energy balance, water usage and the implications of increased agricultural activities related to such projects added to a drumbeat of criticism of the ethanol industry. Moreover, as the price of oil peaked in 2008 to more than $140 per barrel, food prices reached all-time highs and the idea of supporting an industry that was perceived to compete with food supplies for its feedstock became politically untenable as hunger riots broke out in places like Haiti. Most recently, as the price of oil and gasoline plummeted from its 2008 peak to a 2009 low of nearly $30 per barrel, corn ethanol plants began shutting down and several of the major producers declared bankruptcy. In short, the corn ethanol industry began to be viewed nationally as an unsustainable industry, both environmentally and economically.

The Challenge of Producing Sustainable Biofuels

While the corn ethanol industry has struggled with real and perceived sustainability issues since the enactment of EISA, the challenge to wean the nation from a primarily fossil fuel transportation infrastructure has not diminished. The United States consumed more than 140 billion gallons of gasoline in 2008, refined with oil supplied from some of the most geopolitically sensitive and challenging regions in the world. U.S. transportation accounts for some 29% of all GHG emissions, according to EPA, making it one of the biggest contributors to rising temperatures. These factors, combined with the scrutiny surrounding the sustainability of conventional biofuels, led Congress to establish more stringent GHG standards for next-generation biofuels, including full lifecycle accounting of both direct and indirect emissions.

Cellulosic biofuels are thought to potentially be some of the least carbon-intensive fuels. However the examination of indirect and direct land-use impacts of the full production lifecycle of next-generation biofuels raises questions about the true GHG impact of some fuels. Feedstocks which rely on agricultural or harvesting methods for their production may require additional land-use than otherwise would have occurred if that demand for energy production didn't exist. As a result, the EPA is evaluating the manner in which it will assess the significant indirect land-use impacts on GHG emissions, as required by Congress under EISA. The outcome of this analysis could impact the GHG-reducing attributes of some next-generation biofuel pathways.

EISA essentially set forth a policy that calls for the production of large volumes of biofuels from sustainably produced feedstocks that, on a full direct and indirect lifecycle basis, make real GHG reductions. The parallel policy goals of significant lifecycle GHG reductions and increased biofuel production has seemed to some observers a bit paradoxical, as fuel pathways that can produce large volumes of fuel may not necessarily meet stringent GHG reduction standards sought by Congress under EISA.

Meeting the Challenge: Tapping Post-Recycled Waste Materials for Biofuel Production

Waste materials represent one of the largest sources of abundant, cheap and accessible biomass feedstock for conversion to low carbon biofuels. Every year, communities around the country send more than 350 million tons of MSW and C&D to landfills, according to the Waste Business Journal, which does an annual bottoms-up accounting of solid waste activity around the country. The majority of this material – carbonaceous and high in energy content – is literally wasted each year. Moreover, the anaerobic decomposition of waste material in landfills produces methane gas, which is one of the more potent GHG emissions (25 times more than CO2). Finally, landfills are becoming an increasingly scarce disposal solution in the United States. This is especially true for large cities which have run out of space to bury their trash and instead send garbage out of state for disposal incurring significant transportation costs and further exacerbating the increase in transportation CO2 emissions.

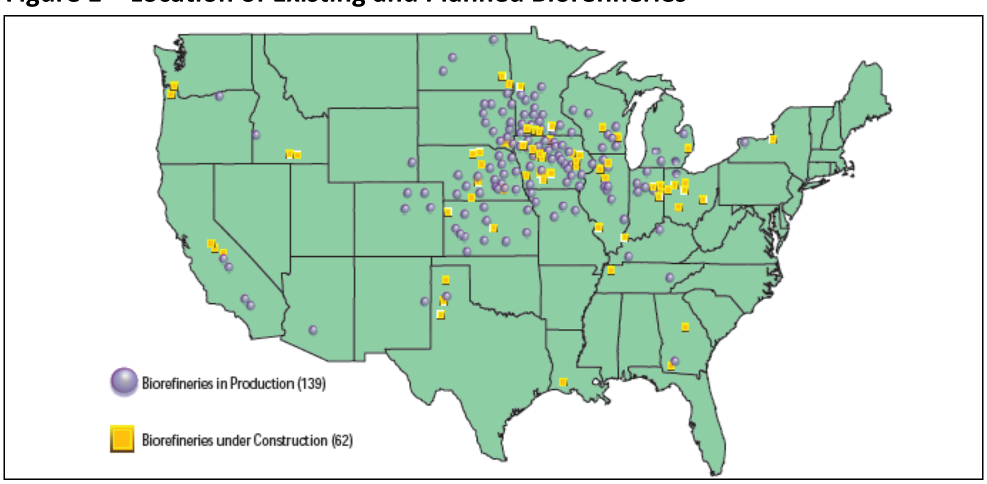
Utilization of the energy embedded in waste streams would provide the Unites States with a low carbon fuel pathway capable of displacing up to 15% of U.S. gasoline consumption annually. As the U.S. attempts to develop a large biofuel industry capable of achieving EISA's policy goals of large volumes of sustainably produced biofuels, it cannot ignore the potential of waste streams as a low carbon biofuel pathway.

The Benefits of Waste Streams as a Feedstock for Biofuels

Waste is an Abundantly Available Feedstock

Waste streams are abundantly available in every market around the country, particularly near high population centers. As shown in Figure 1, the biofuel infrastructure exists in some of the least populated areas of the country, forcing biofuel producers to ship fuel or feedstock to the larger markets for consumption or biofuel production. As such, the logistics make conventional biofuels relatively expensive to bring to market and further increase CO2 emissions as a result of this transportation requirement.

Figure 1 – Location of Existing and Planned Biorefineries



Source: Renewable Fuels Association.

In contrast, the generation of waste materials directly correlate to population size and transportation fuel demand. In areas that demand the most transportation fuel, there exist the largest supplies of waste feedstock for conversion into biofuels. Moreover, the collection infrastructure already exists in neighborhoods all around the country. Each week, garbage trucks haul away waste to be processed, recycled and ultimately landfilled. Waste-derived biofuel producers can work with communities and solid waste companies to divert waste material from landfills following all available recycling activities – essentially the waste that would otherwise be landfilled. By siting waste conversion facilities relatively close to urban markets, fuel producers can take advantage of existing infrastructure and ideal logistics where the feedstock is produced close to those who drive cars and purchase gasoline.

Table 2 – Solid Waste Market Volume in 2008 *(In Millions of Tons Annually)*

	Volume	%
Total MSW Generation	505.5	NA
Recovery	144.8	28.6%
Post-Recovery	360.8	71.4
Net Exports	(4.3)	NA
Total Disposal	365.0	72.2
Landfilled	339.7	67.2
Processed by W-t-E	25.6	5.1

Source: Waste Business Journal's *Waste Market Overview and Outlook 2009*.

Waste is the Cheapest Feedstock Available for Biofuel Production

Waste materials are a significant cost to communities who pay for their hauling, processing, recycling, composting and ultimate disposal activities. Despite increased recycling activities around the country, millions of tons of waste continue to end up in landfills each year. The cost of siting, permitting, filling and managing landfills is tremendous – causing some communities to pay upwards of $60-100 per ton of trash, collectively amounting to millions of dollars a year for ratepayers.

Alternative uses of the carbonaceous portion of waste – between 65% and 85% of the volume – can be far more effective. Additionally, as a feedstock for biofuels, waste has a zero or negative cost. No other biofuel feedstock has such favorable economics, which is why the waste-to-fuels pathway is the most economical source of low-cost biofuels. In the EPA's proposed RFS-2 program, it suggested that:

> *"Cellulosic feedstocks available at the lowest cost to the ethanol producer will likely be chosen first. This suggests that urban waste which is already being gathered today and which incurs a fee for its disposal may be among the first to be used."*

Indeed, waste materials will produce the lowest cost biofuels – well below $1.00 per gallon in operating costs.

Utilizing Waste for Biofuels Provides Large GHG Reductions with Zero Indirect Land-Use Impact

The utilization of waste streams for biofuels provides excellent lifecycle GHG reductions. Because waste is collected prior to its disposal and it is not grown or harvested, waste has no negative indirect land-use impacts on GHG emissions. In fact, because waste is diverted from landfills, the generation of methane emissions is avoided. Additionally, waste converted to fuels can be accomplished in a clean, responsible manner, utilizing a low emissions process that does not incinerate or burn the waste material. In total, utilizing waste streams for biofuel production will yield between 60-75% reductions in GHG emissions relative to petroleum-derived gasoline production.

Enough Landfilled Waste Exists in the U.S. to Significantly Displace Gasoline Consumption

In addition to possessing ideal collection and aggregation logistics, waste exists in large volumes in markets all over the country. Depending on various estimates, between 250 and 500 million tons of solid waste are generated each year. After taking into consideration the national recycling average of nearly 30%, approximately 175 to 350 million tons are landfilled each year. Conservatively assuming that 50% of this material is convertible to fuels, this represents a production potential of between 10 – 21 billion gallons of ethanol annually. In other words, diverting and converting solid waste after recycling – that would otherwise be landfilled – could make up between 50% - 100% of the Advanced and Cellulosic Biofuel requirement as mandated by EISA. Moreover, this contribution would be from a feedstock with no indirect land-use impact, which results in additional lifecycle GHG reductions of between 60-75%.

Fulcrum's Waste-to-Fuel Conversion Technology is Ready for Commercialization

Extensive Technology Development

Fulcrum reviewed more than 100 new technologies that might be used for the production of ethanol from MSW. The review included gasification, acid hydrolysis, bio-processes, numerous combination processes as well as several Fischer-Tropsch type processes. At the conclusion of the screening process, Fulcrum determined that the thermochemical technologies offered the best ethanol yields and overall economics amongst the new, emerging technologies.

This conclusion led Fulcrum to enter into long-term technology license agreements with InEnTec for the gasification technology and Nipawin and SRC for the gas-to-liquids technology. The Fulcrum Process converts organic waste materials to cellulosic ethanol, utilizing new technologies in a two-step thermochemical process. In the first step, cellulosic and other organic materials recovered from post-recycled MSW are gasified in the IET Technology's down-draft partial oxidation gasifier followed by a plasma arc. This equipment, licensed from IET, provides a highly efficient method of creating a syngas, which consists mainly of H_2, CO, and CO_2. In the second step, the syngas is catalytically converted to cellulosic ethanol through an alcohol synthesis loop process developed by Fulcrum using the Nipawin/SRC Technology, a new, proprietary catalyst technology developed by and licensed through Nipawin and SRC.

Combined with existing commercial sub-systems obtained from outside vendors, Fulcrum's technology and plants are being designed with redundancy and the ability to scale up. This development allows Fulcrum to build efficient, larger plants each with the capacity to produce as much as 90 million gallons of cellulosic ethanol per year.

Project Sierra BioFuels

After securing the technology rights and completing the detailed development of these technologies into a commercial-ready system design, Fulcrum's technology is ready to be demonstrated at a commercial scale in its first fully integrated project, a 10.5 mgpy facility located outside of Reno, NV called Project Sierra.

Fulcrum is completing engineering and pre-construction work for Project Sierra and estimates Project Sierra to be operational in 2011. Utilizing new, innovative thermochemical technologies, Project Sierra will convert the organic matter in post-recycled MSW into a clean, sustainable, and renewable transportation fuel.

Project Sierra has secured all of its major permits, necessary to begin construction. Storey County, Nevada and the local community have been very supportive of Project Sierra.

Building a Waste-Derived Biofuels Industry in the Right Way

Complementary – Not Competitive – With Recycling

It is important that a policy, which fosters a waste-derived biofuels industry, does not do so at the expense of current and future recycling programs. The recycling of metal, paper and plastic products provides innumerable environmental benefits. Recycling reduces the use of virgin materials for everyday goods and prevents over-deforestation, a critical component in the fight against climate change. The current recycling average is approximately 30% throughout the United States, although that figure tends to be higher in and around urban markets and lower in more rural and less populated areas. It is sound policy to advocate for increases in recycling to combat climate change and reduce our use of virgin materials. However, millions of tons of waste still end up in landfills each year, even in markets like California or New England, where recycling rates are relatively high.

A strong recycling policy and a waste-derived biofuel policy are not mutually exclusive. Indeed, a well designed waste derived biofuels process, like Fulcrum's, actually includes a recycling component to enhance existing programs or to implement a form of recycling where it has not yet been adopted. As the table below illustrates, even with a very high national recycling average of 70%, there is still the potential to divert at least 75 million tons of waste from landfills annually to produce at least 9 billion gallons of biofuels, representing nearly half of the Advanced Biofuels blending target under RFS-2.

In this regard, biofuel produced from waste material can and should be completely synergistic with a robust recycling policy.

Table 3 – Recycling & Biofuel Production from Waste Materials: Complementary Policies

Solid Waste Generation (in Millions of Tons)(2)	Assumed National Recycling Rates	Available Feedstock (in Millions of Tons)(2)	Biofuel Production (in Billions of Gallons)(3)
500	30%	175	21
500	40%	150	18
500	50%	125	15
500	60%	100	12
500	70%	75	9

(1) Source: Waste Business Journal's *Waste Market Overview and Outlook 2009*.

(2) Assumes 50% of post-recycled waste is usable as feedstock across the nation.

(3) Assumes Fulcrum's feedstock-to-ethanol conversion rate of 120 gallons per prepared ton of feedstock.

Meeting the Highest of Environmental Standards

The conversion of waste materials to syngas and then to biofuels is a clean, environmentally friendly process that reduces GHG emissions by more than 75%. Fulcrum's technology produces a syngas from the conversion of waste, using a non-incineration technology that gasifies the waste material in a controlled environment. Additionally, the syngas is rigorously scrubbed and purified to meet the stringent technical criteria of the gas-to-liquids conversion process.