National Agricultural Research, Extension, Education and Economics Advisory Board

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Report and Recommendations of the Renewable Energy Committee of the National Agricultural Research, Extension, Education and Economics (NAREEE) Advisory Board

Executive Summary: The Renewable Energy Committee (REC) of the National Agricultural Research, Extension, Education and Economics (NAREEE) Advisory Board was established in 2008 and charged to study the scope and effectiveness of research, extension and economics programs within the USDA Research, Education and Economics (REE) mission area.

The 2010 report addresses previous recommendations in greater detail identifying a long term forward thinking approach to research, education and economics with respect to renewable energy. The Renewable Energy Committee developed recommendations which address USDA/REE's emphasis in Bioenergy:

- **USDA/REE should validate the development of a cellulosic feedstock system and determine which feedstocks indicate significant sustainable potential in various regions of the US.**
- **USDA/REE should support cross-functional educational and outreach programs in agriculture, chemistry and engineering disciplines to support a new workforce that has a strong foundation in chemurgy skills.**
- **USDA/REE should increase resources to support research and cross-functional educational programs to address challenges for utilization of agricultural derived bioproducts and biomass.**
- **USDA/REE should evaluate bio-power from biomass in terms of efficiencies, regionalization, liquid fuels and electricity. REE also should effectively communicate its vision and the potential scope and research needs for biomass crops.**
- **USDA/REE should continue to support the Global Strategy to Improve Agricultural and Rural Statistics Report of which ERS and NASS are an integral part and also should broaden the scope of its data analysis to include the Forest Service and NRCS.**

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Background

Title IX of the 2008 Farm Bill includes a range of authorities for renewable energy research and development. The Renewable Energy Committee (REC) of the National Agricultural Research, Extension, Education and Economics (NAREEE) Advisory Board was established in 2008 and charged to study the scope and effectiveness of research, extension and economics programs within the USDA Research, Education and Economics (REE) mission area. The NAREEE Advisory Board's Renewable Energy Committee met by conference calls throughout the year to assess academia, industry and stakeholder renewable energy programs and initiatives. The Renewable Energy Committee findings were subsequently presented and discussed at the full NAREEE Advisory Board meetings held in April and November 2009, and April 2010 in Washington, DC. Carol Keiser-Long, Chair of the Renewable Energy Committee consulted and interacted with the Department of Energy Biomass Research and Development Technical Advisory Committee quarterly meetings. In addition, the Chair attended biofuel meetings throughout the year reporting back to the Renewable Energy Committee and to NAREEE Advisory Board.

The Secretary of Agriculture and the Under Secretary for REE feel strongly about the importance of bioenergy and the role of USDA - particularly the Research, Education, and Economics mission area in accomplishing measurable outcomes. The Renewable Energy Committee explored knowledge gaps and provided input on which facets of bioenergy research are the most critical and also the most attainable by USDA research.

Subsequently, the Renewable Energy Committee developed the five following recommendations to support USDA's emphasis in Bioenergy:

USDA/REE should validate the development of a cellulosic feedstock system and determine which feedstocks indicate significant sustainable potential in various regions of the US.

After two decades of research without a sustainable technical breakthrough to make cellulosic ethanol competitive, it appears that it is time to reevaluate the research. There are two additional options for consideration. First, cellulosic biomass to power (burning to produce electricity) has real potential for being a useful bridge for cellulose to ethanol. With this approach, it can at least be demonstrated that large amounts of cellulose can be grown, harvested, stored, transported, and used to produce electricity. This would validate the development of a cellulosic feedstock system. Second, there are a number of new feedstocks, such as algae and other oil seed crops, that seem to hold significant potential. Although significant funding has positioned algae as a biofuel feedstock, additional efforts are needed. New feedstocks including sweet sorghum and sugar beets lack significant research to more fully understand their role in a renewable fuel system for this country.

Given the number of climate zones in the US, different feed-stocks must be grown in different regions of the country. Primarily, growing feedstock is outdoor manufacturing, so the production is always at the whim of the weather. Having diverse biomass production systems spread over many states will lower the risk of the system and assure an adequate supply. With many different feedstock crops being grown in different climates, the production system gives almost every state an opportunity to provide renewable fuel for this country. Other advantages include the use of existing infrastructure for these new crops, and utilizing local labor and other resources.

USDA/REE/NIFA should develop cross-functional educational and outreach programs in agriculture, chemistry and engineering disciplines to support a new workforce that has a strong foundation in chemurgy skills.

Domestic production of key chemical intermediates also is paramount for national security. During WWII, agricultural derived chemicals and fuels were a critical source of raw materials for the war effort. These efforts were highlighted in Time Magazine Monday, April 12, 1943: "For eight years the National Farm Chemurgic Council has tried to solve the farm problem by promoting diversified crops of use to industry. But today the farmer needs manpower, not new markets. It is industry that needs chemurgy, not the farmer. Without agricultural help, rubber, alcohol and explosives programs would be facing disaster." Today, with proper focus to the highest risk areas, new educational and research programs should be implemented to address these challenges for utilization of agricultural derived bioproducts.

It will be critical to develop cross-functional educational programs in agriculture, chemistry and engineering disciplines to produce a new workforce that has a strong foundation in Chemurgy (*The branch of applied chemistry concerned with preparing industrial products from agricultural raw materials* William Hale, Dow chemical

consultant, credited for "chemurgy" in 1934 book *The Farm Chemurgic).* The following more recent quotes point out that renewable energy and other products will be a key area for future education, research and employment in the United States:

- David Harwell (assistant director, Dept. of Career Management and Development, American Chemical Society): "People still want stuff…eventually; people will have to make the stuff." When the economy turns around there should be chemical professionals.
- Kevin Swift (chief economist, American Chemical Council) "The chemical industry is a very exciting and innovative industry. Lots of the solutions to the nation's problems, such as stemming climate change and developing renewable energy, will come from chemists."
- Robert Peoples (director, ACS Green Chemistry Institute): "There will be huge opportunities in green chemistry going forward. If you think, for example, of renewable energy, and conversion of biomass to renewable chemical building blocks and fuel, there is a huge gap in our knowledge that needs to be filled by the chemical community" he also pointed out that with 80,000 or so chemicals in commerce, chemists might need to develop green chemistry processes or alternatives for about 50,000 of them.

USDA/REE should increase resources to support research and cross-functional educational programs to address challenges for utilization of agricultural derived bioproducts and biomass.

The U.S. petroleum and petrochemical industries exist together to leverage feedstocks and processing capabilities to maximize value. The U.S. Chemical industry is vital to the sustainability and energy independence of the US economy. It generated $689 billion in revenues in 2008 and accounts for approximately 10% of all US exports. Jessica Marshall highlighted the comparable pretax value of petrochemicals vs. transportation fuels in a July 2007 article "Biorefineries, Curing our addiction to oil," in the New Scientist magazine. This model should continue to be examined as feedstock selection and technology develop for the growing biomass economy. Additional supplemental studies to the DOE 2004 report "Top Value Added Chemicals from Biomass" should be initiated. New studies should highlight those core commodity chemicals that could make the highest impact on the US economy. A prioritized listing of bioproduct opportunities should be used as a guide for future USDA investments in research. Top consideration should be given to those chemicals/products that are direct replacements for chemicals used in existing product lines. Opportunities to leverage agricultural/biomass feedstocks for use in existing US chemical infrastructure with appropriate modification should be explored.

Additional work should focus on those chemicals that pose the highest risk to the US chemical raw material supply chain if no domestic sources are available.
In addition to the supply issues, the chemical industry is a critical sector for highly skilled US labor. Approximately 850,000 direct jobs are supported by the US chemical industry. Another 4.25 million jobs are created in supporting industries tied directly to primary

manufacturing. With many job losses and chemical operations leaving North America to be closer to lower priced raw materials (petroleum/natural gas), the US chemical industry runs a high risk of falling into a downward spiral. However, this dark cloud has a silver lining. Many biomass chemical opportunities or combined chemical/fuel initiatives create more sustainable value propositions and expanded employment opportunities when compared with those that focus solely on liquid biomass transportation fuels.

USDA/REE should evaluate biopower from biomass in terms of efficiencies, regionalization, liquid fuels and electricity. REE also should effectively communicate its vision and the potential scope and research needs for biomass crops.

The Renewable Energy Committee supports evaluation of bio-power from biomass. Challenges and opportunities for effectiveness of research, education and economics of biomass are improvements of efficiencies, regionalization, liquid fuels, and electricity from biomass. REE also needs to effectively communicate its vision and the potential scope and research needs for biomass crops.

The successful development and production of next generation biofuels are likely to require conversion of agricultural land to the production of energy crops as well as the harvest, collection, transportation and storage of these crops. Creating a supply chain adequate to support a large-scale advanced biofuels industry is a tremendous logistical challenge. The length of time required to cultivate and process high-yield dedicated energy crops begs for near-time uses of these crops that will jump-start the feedstock supply chain and help to identify and overcome challenges.

The key near-term opportunity may lie in the thermal conversion of biomass, either through direct combustion or gasification. The scale of these facilities can range from pellet furnaces for home heating to biomass co-firing at large coal-fired electric generation facilities. USDA has introduced some programs to encourage these near-term uses (for example, the Biomass Crop Assistance Program). However, there are research gaps in many aspects of this supply chain even to support the thermal conversion market. For example, these gaps include lack of information on the following five areas:

- Biochar: the conversion of biomass on-site at farms to a liquid feedstock with the biochar byproduct returned to the soil could significantly reduce the logistics of transporting and processing high-volume bulky biomass to end users.
- Densification: Increased densification of biomass would reduce the volume of material moved and, therefore, the amount of truck traffic, fuel burned and greenhouse gasses emitted.
- Pelletizing: Energy crops are difficult to grind and pelletize. Many thermal uses require or prefer pelletization to improve material handling or integrate with existing fuels and fuel handling systems.
- Grower Models: A biomass feedstock supply chain may require new models of cooperative ownership among biomass producers.

- Crop Support: As perennial crops with relatively high establishment costs, energy crops represent a long-term commitment by growers. What are the appropriate long-term agricultural policy instruments to properly incentivize and protect energy crop producers?

USDA/REE should continue to support the Global Strategy to Improve Agricultural and Rural Statistics Report of which ERS and NASS are an integral part and also should broaden the scope of its data analysis to include the Forest Service and NRCS.

The Global Strategy Report, prepared by the World Bank in collaboration with the Food and Agricultural Organization of the United Nations (FAO), is the result of an extensive consultation process with national and international statistical organizations as well as with agriculture ministries and other governmental institutions represented in FAO governing bodies. Considerable input came from the United Nations Statistical Commission working group that included representatives from the USDA Economics Research Service (ERS) and National Agricultural Statistics Service (NASS).

The purpose of the Global Strategy Report is to provide a framework for national and international statistical systems that enable them to produce the basic data and information needed to guide decision making in the 21st century.

What does this mean to the USDA?

The USDA statistical system sets the gold standard for international statistics. However, the Global Strategy Report still presents challenges because of the emerging data requirements related to direct and indirect land use, climate change and water scarcity. The USDA needs to integrate the different statistical activities underway in the Department. These activities include:

- The NASS statistical program which makes extensive use of administrative and other data coming from the Food Safety and Inspection Service, the Agricultural Marketing Service, and the Foreign Agricultural Service. Also, NASS has a master sampling frame for agriculture based on its area sampling frame and records from the Census of Agriculture. NASS also has a strong capability to utilize satellite imagery to produce land use data layers.
- NASS and ERS collaborate on the Agricultural Resource Management Survey (ARMS), which provides a timely, and up-to data picture of the economic situation of the nation's farms and agriculture. The ARMS is in effect an integrated survey in that it links different issues regarding agriculture. However, it is not directly linked to farm and rural households nor is it geo referenced to land use.
- Natural Resources Conversation Service (NRCS) conducts the National Resources Inventory (NRI), which is a statistical survey of natural resource conditions and trends. It provides consistent statistical data on how land is used and on changes in land use patterns. Land uses of

interest are those involving the production of agricultural and timber products. This survey sets a gold standard on how to measure and monitor land use. A major problem is that it is done outside the remaining USDA statistical system with no connection to the crop and livestock production that takes place on neither the land it monitors nor the economic or social situation of farms and households using the land.

- The Forest Service (FS) conducts the Forest Inventory and Analysis program. It reports on the status and trends in forest areas and location, removals by harvest and wood production and utilization. It has recently enhanced the program by expanding the scope of data collection to include data on soils. There is an element of forestry linked to agriculture, which includes woodlands that are part of an agricultural enterprise. However, the Forest Inventory Program also takes place outside the remaining USDA statistical systems, thus denying the integration of its findings with other land uses as well as related economic and social well being of the population depending upon the harvest of forests.

The need for these different statistical systems to be linked can be seen from the data requirements coming from the stated goals to produce 36 billion gallons of biofuels and 100 million gallons of cellulosic biofuels per year. These targets will require the development of expanded commodity sectors, will affect land and water use, and compete with existing food, feed, and fiber markets.

Economic, environmental and social issues faced as a consequence of these initiatives need to be considered to ensure the sustainability of all components of the supply chain including markets and investments and to protect the natural resources such as soil, water, and the air. In addition, the impact of the biomass utilization on the rural communities also needs to be considered. This includes understanding the impact on farm and rural household income, job creation and loss, and demands on the local infrastructure.

The Global Strategy Report to improve agricultural and rural statistics provides a framework for national and international statistical systems that enables them to produce the basic data and information needed to guide decision making in the 21st century. Policy makers and development practitioners who are responsible for developing investment strategies to promote economic growth find many challenges in the changing face of agriculture in the 21st century. In addition to its productive role providing the food, clothing, fuel, and housing for a growing world population, agriculture assumes other roles, the importance of which has more recently been recognized. In addition to its essential role in food security, agricultural development is now seen as a vital and high-impact source of poverty reduction in developing countries. It is also seen as a source of environmental problems and a contributor to climate change, water scarcity and pollution, and land degradation. At the same time its potential as a source of environmental services needs to be defined, monitored, and evaluated. Many of the issues facing the sector transcend national boundaries.

The Committee reaffirms these recommendations. In addition the Committee believes that USDA should broaden the scope of its analysis to recognize that the US exists in a global marketing and environmental framework that means decisions and actions taken in other parts of the world will affect the outcomes of decisions made within the US. A final recommendation is that a USDA Statistics Council be formed that brings together all agencies that produce statistics to begin the process of integrating efforts to produce the required information as efficiently as possible.

SUMMARY

New and enhanced research and educational initiatives in renewable energy require additional funding or the reallocation of existing resources, which may alter current program priorities. USDA has a track record of successful research, education, and extension activities in feedstock production; conversion technology, new uses and technology transfer already in place. Therefore, the Renewable Energy Committee believes that strategic capitalization on the successes should be used in encouraging a global baseline of statistics and economic analysis approach, validating development of a cellulosic feedstock system, and enhancing research and educational programs for workforce development and biopower from biomass crops.

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