



United States
Department of Agriculture

Research, Education,
and Economics Mission Area

STRATEGIC ENERGY SCIENCE PLAN

FOR RESEARCH,
EDUCATION, AND EXTENSION

March 2008



Role: *Lead Research, Education, and Extension programs for sustainable production of agriculture-based and natural resource-based renewable energy and efficient use and conservation of energy — for the benefit of rural communities and the Nation*





STRATEGIC ENERGY SCIENCE PLAN FOR RESEARCH, EDUCATION, AND EXTENSION

Vision:

“Growing a clean, efficient, sustainable energy future for America”

We have a vision that in 5 years the United States will have:

- Agriculture- and natural resource-based energy that enhances stewardship of our environment
- Sustainable, secure, renewable energy sources
- Vibrant and energy-efficient rural communities

“USDA — a recognized leader in innovative energy solutions”

We have a vision that in 5 years the United States Department of Agriculture will have:

- A workforce with expertise and foresight to address renewable energy challenges
- Robust partnerships with Federal agencies, universities, and the private sector
- A fully integrated, systems approach to national and regional energy needs

Goals:

- Sustainable agriculture- and natural resource-based energy production
- Sustainable bioeconomies for rural communities
- Efficient use of energy and energy conservation
- Workforce development for the bioeconomy

INTRODUCTION TO THE STRATEGIC ENERGY SCIENCE PLAN



Securing America's energy future is among the most important challenges today, and agriculture can play an important role in bringing about energy solutions. The USDA Research, Education, and Economics (REE) mission area strives to create public benefit through both internal activities and partnerships with other USDA agencies, Federal agencies, university partners, nongovernmental organizations, and the private sector. To this end, REE has developed a Strategic Energy Science Plan for Research, Education, and Extension (the Plan), which is presented here. The Plan builds upon the many excellent energy-related activities and programs undertaken by the REE agencies and partners.

The Plan will be used to establish a focus and to facilitate collaboration by providing a unifying vision and goals for energy activities in a cohesive package. This will facilitate efforts by agencies and individuals to better understand the role of agriculture's research, education, and extension programs and activities directed toward the goals

of sustainable production of energy and biobased products, efficient energy use, and energy conservation. USDA defines "sustainability" as satisfying, now and over the long term, our Nation's needs for food, fiber, feed, and fuel, while at the same time maintaining or enhancing environmental quality, rural economic vitality, and quality of life. The Plan recommends a holistic approach that includes whole life-cycle assessments/analyses that encompass interdependent-

... create public benefit through both internal activities and partnerships ...

systems approaches to bioenergy and biobased product technologies, adoption processes, decision support systems, and educational programs. It encourages technologies that minimize disruption to existing markets for food, feed, and fiber. These technologies will affect a diverse range of feedstocks and biofuels, with varying impacts on regional and local economies.

In January of 2007, REE initiated an aggressive program to empower all within its system to focus on energy. Planning and evaluation activities led to a September 2007 strategic planning workshop. The workshop brought together over 100 scientific and administrative leaders from the REE mission area agencies (Agricultural Research Service [ARS], Cooperative State Research, Education, and Extension Service [CSREES], Economic Research Service [ERS], and National Agricultural Statistics Service [NASS]), non-REE USDA agencies, other Federal agencies (e.g., U.S. Department of Energy [DOE], U.S. Environmental Protection Agency [EPA]), and



university partners, especially the Land-Grant University (LGU) System. This Plan represents the principal outcome of the workshop. The Plan has been circulated to all the REE agencies and university partners. Suggestions received were incorporated into the Plan. The workshop clearly showed that the pace of technology development in the energy sector is accelerating. Consequently, the Plan will be adjusted as progress is made.

The Plan provides a transparent view of REE's proposed activities in energy research, education, and extension. It is intended to facilitate interagency, university, and private sector coordination and cooperation. Its main objective is to pursue reliable and sustainable sources of agriculture- and natural resource-based energy and biobased products, promote the health of rural communities, and provide responsible stewardship for our natural resources for generations to come. The Plan is ambitious, but it identifies realistic goals that can be achieved over the next 5 years. It incorporates the significant achievements and the expertise that the REE agencies and university partners have already brought to the renewable energy arena. The Plan focuses on areas where the REE mission agencies and universities have unique capacities and resources that will complement those of other agencies, both within and outside USDA.

These unique capacities and resources include:

- Regional and local outreach
- Genetic resources, collections, and crop breeding/genetics/genomic expertise for feedstock development

- A systems approach to feedstock development, production, and conversion
- Feedstock logistics (harvest, transportation, storage, and pre-treatment)
- The use of animal manures, crop and forest residues, and other residuals as feedstocks
- Development of biobased products and value-added coproducts
- A network of dedicated laboratories for performing basic and applied research, which serve the technology needs of current and future USDA stakeholders
- Sustainability
 - Environmental
 - Social
 - Economic
- Integration of basic and applied research, education, and Cooperative Extension in land-grant universities
- Integration and coordination of activities among the REE agencies (ARS, CSREES, ERS, NASS)

The main objective is to pursue reliable and sustainable sources of agriculture- and natural resource-based energy and biobased products, promote the health of rural communities, and provide responsible stewardship of our natural resources for generations to come.

OBJECTIVES

The REE mission area will develop clear leadership and a high-performing organization to accomplish the following 5-year objectives:

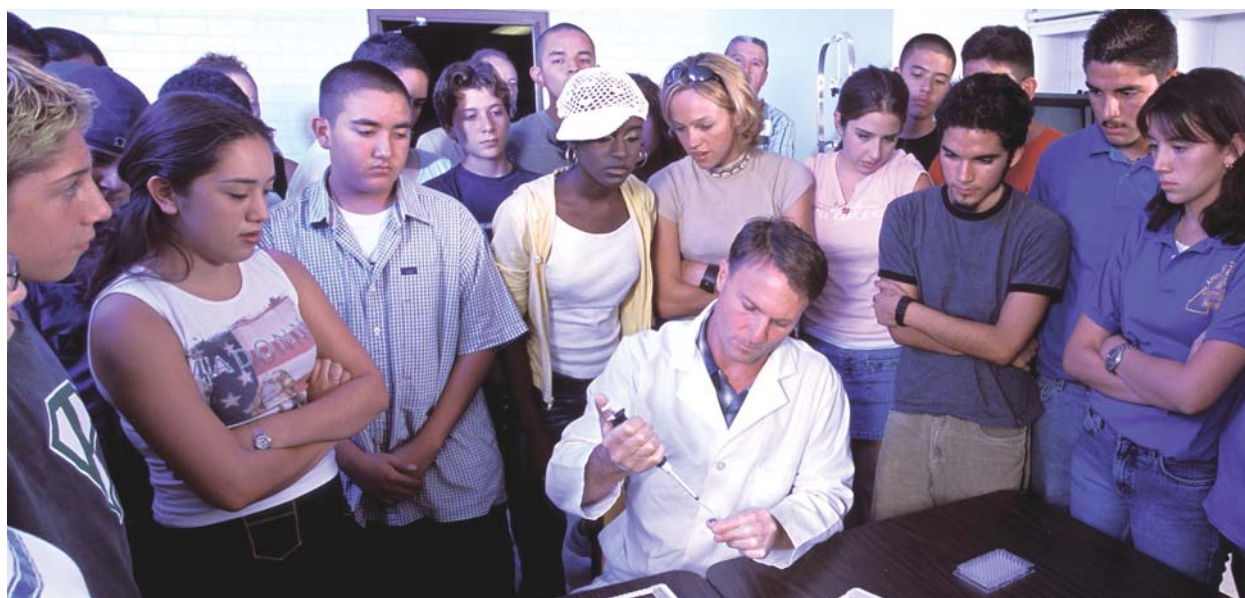
- The Plan is recognized for its innovation across REE, USDA, Federal agencies, Congress, and the university community.
- The Plan and programs are incorporated into the U.S. national energy strategy and action plans.



- All initiatives are successfully implemented, with outcomes continuously re-evaluated and executed for maximum achievement.
- A strong network of partners with a shared vision is in place.
- Vibrant and effective public and private partnerships focused on specific issues with defined scopes exist at the national, regional, State, and local levels.
- Organized educational partnerships, including youth and adult education as well as college curricula, are in place.
- Well-established marketing partnerships with scientific, educational, and industrial organizations are functioning. These partnerships will ensure high visibility for REE efforts and provide awareness of emerging issues.

The REE mission area will achieve the above 5-year results using the following key strategies:

- Align internal agencies and partners (e.g., Forest Service [FS], Natural Resources Conservation Service [NRCS]), and external partners (e.g., DOE, EPA, land-grant universities, and industry), and then identify and recruit external partners based on shared vision and needs to address specific topics and functions.
- Use existing energy committees and initiatives to promote the Strategic Energy Science Plan and programs (e.g., Agricultural Bioenergy Bioproducts Research Education and Economics [ABBREE]; Biobased Products and Bioenergy Coordination Council [BBCC]; Energy Council; Biomass R&D Board; National Agricultural Research, Extension, Education Economics Advisory Board [NAREEEAB]; Biomass Research and Development Technical Advisory Committee).
- Initiate joint planning that will result in progress through collaboration.
- Develop voluntary, stakeholder-driven, and credible certification systems to ensure sustainability of bioenergy and biobased products.
- Convene an annual REE bioenergy summit to both maintain buy-in of the Plan and track implementation of programs, as well as to identify new and emerging opportunities.
- Demonstrate incentives for partnerships with prospective and current partners by surveying what has worked historically.
- Take full advantage of USDA's communication infrastructure (e.g., CSREES' on-line magazine (E-zine) and Partners video and ARS' *Agricultural Research* periodical).



KEY ACTIVITIES

The REE Energy Leadership Team will establish mechanisms for accountability and tracking progress for the Plan across USDA/REE. Other important activities over the next 24 months will include the following:

- Establish semi-annual (or quarterly) review of coordination activities with Biomass R&D Board, Energy Council, BBCC.
- Continue the monthly “Intersection of Agriculture and Energy” seminar series.



- Establish a one-stop USDA Bioenergy Web site (work with Rural Development [RD] on existing USDA Energy Web page and matrix).
- Establish eXtension Communities of Practice to engage users of energy information.
- Plan and conduct BioEnergy Awareness Day.
- Convene REE Energy Leadership Team meeting to develop a 5-year action plan and schedule regular implementation team review meetings.
- Convene partnership summit to build a shared vision and identify areas for collaboration.
- Communicate and promote the Plan internally and externally.
- Develop, in conjunction with the LGUs, a comprehensive inventory of all scientific, educational, and industrial bioenergy organizations, and establish Web-based databases of key partners and contact information.
- Establish an advisory group to address the legal, policy, and functional aspects of interagency synergies.
- Initiate 30-second spots to highlight the USDA/REE focus on energy via public service and other television outlets. Identify additional media outlets for publicizing USDA/REE energy and biobased product activities.



SUSTAINABLE AGRICULTURE- AND NATURAL RESOURCE-BASED ENERGY PRODUCTION

Results by 2012:

- A single portal for data systems supporting comprehensive economic and environmental models that address the key issues and guide decisionmakers.
- Whole life-cycle analyses of at least two potential regionally appropriate production systems.
- High-quality, cost-effective feedstocks are developed.
- High-quality, cost-effective feedstocks are sustainably produced following REE science-based conservation plans.
- Demonstrate at least two scalable conversion technologies suitable for regional energy production.
- Sustainable integrated harvesting, transportation, storage, conversion, and distribution systems exist.
- Analysis of environmental and economic impact of bioenergy production will have been conducted at the regional and national levels.
- Analytical tools have been developed to assess the site-specific impacts of bioenergy feedstock production.
- Decision tools are available to help farmers, energy producers, and rural communities consider their participation in alternative-energy production systems.
- Comprehensive databases of feedstock characteristics are publicly accessible.
- Voluntary, stakeholder-driven, and credible certification systems are in place to ensure sustainable bioenergy production.

Key Strategies:

- Evaluate existing and develop new economic and biophysical effects models to assess the sustainability of regional production of energy and products.
- Assemble a critical mass of genetic resources, biological information, and expertise to develop one or more sustainable energy biomass crops or crop mixtures for each region.
- Identify, charge, and seek funding for multidisciplinary teams that will develop genetic, production, harvesting, storage, and conversion technologies and methods to support energy and coproducts availability; and for the development of subsequent educational strategies to facilitate adoption.
- Utilize tools and partnerships to facilitate research and education issues (i.e., DOE for scalable technologies, Sun Grant Initiative [SGI], and DOE on regional biomass studies) and to inform decisions at the local, regional, and national levels.
- Identify and use metrics for environmental, economic, and social concerns to guide activities and research.
- Leverage existing agricultural and natural resource production expertise and technology.
- Build and assess databases to capture core elements of production impacts on sustainability.
- Develop risk mitigation and decision support systems.
- Facilitate development and adoption of credible certification systems to ensure sustainability of bioenergy.

GOAL 2:

SUSTAINABLE BIOECONOMIES FOR RURAL COMMUNITIES

Results by 2012:

- Decision tools are available and training in their use is provided to all farmers, rural communities, and processors anticipating bioenergy production systems. Decision tools are available to policymakers supporting future industry development, including the sustainable production and marketing of biobased products and coproducts.
- Cooperative Extension educators are fully trained to support farmers, processors, and rural communities participating in the bioenergy/bioeconomy as well as those who must make major business strategy adjustments due to the emerging bioeconomy.
- eXtension Communities of Practice are formed to support farmers, processors, and rural communities participating in the bioenergy/bioeconomy.
- Biobased products and bioenergy coproducts have been evaluated for sustainability and market potential for regional integrated bioeconomies.
- Those farmers, communities, and processors displaced by a growing bioenergy industry in transitioning to new viable economic activities are assisted.



Key Strategies:

- Use environmental, economic, and social analyses as tools to guide activities and research.
- Train new and existing Cooperative Extension personnel to support activities within the rural bioenergy/bioeconomy and transitioning agricultural sector.
- Organize eXtension Communities of Practice and develop Web-based interactive user information.
- Evaluate market potential of biobased products and coproducts as part of the rural bioeconomy portfolio.
- Evaluate and understand the changing market conditions for traditional agricultural commodities.
- Develop new and enhance existing tools and partnerships to inform decisions at local, regional, and national levels.

GOAL 3:

EFFICIENT USE OF ENERGY AND ENERGY CONSERVATION

Results by 2012:

- Energy education programs, including eXtension Communities of Practice, are established by Cooperative Extension personnel to reach both traditional and nontraditional audiences.
- Energy intensity of agricultural production is reduced by 10 percent.
- Establish a national agriculture- and natural resource-based energy awareness campaign.
- Promote energy conservation awareness across the United States.

Key Strategies:

- Lead in establishing a national energy extension network in partnership with land-grant universities and Federal agencies.
- Establish energy Communities of Practice in eXtension.
- Develop and publicize decision support tools for home energy and on-farm energy conservation.
- Establish an energy garden at the National Arboretum in collaboration with a national conservation group.
- Develop a university-based program for energy conservation education.

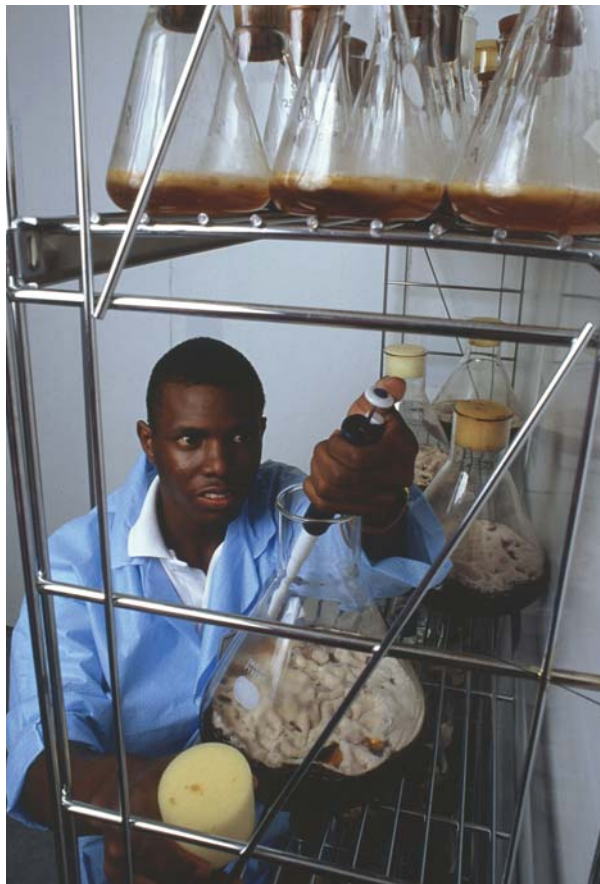


GOAL 4:

WORKFORCE DEVELOPMENT FOR THE BIOECONOMY

Results by 2012:

- Triple the number of students in college- and university-based bioenergy and bioeconomy education programs.
- A large proportion of high school students are aware of and take action on bioenergy concepts and agriculture and natural resource roles in developing the country's energy future.
- Expertise is available to implement Cooperative Extension energy programs across all States.



Key Strategies:

- Establish and publicize a roadmap of educational activities that will lead to careers in bioenergy and the bioeconomy.
- Conduct a workforce needs assessment for the local and regional bioeconomy sector, including projections of all roles.
- Coordinate educational programs where appropriate to develop national-scale centers of research and education (K-20 and adult and informal programs) delivered through robust distributed educational programs in every region.
- Add significant numbers of graduate- and postgraduate-level grants to existing programs with a focus on bioenergy.
- Increase to at least 50 percent the number of LGUs offering bioeconomy courses.
- Increase Higher Education Challenge Grant funding and emphasis on distance education.
- Increase the number of REE bioenergy curriculum development grants.
- Establish and increase the number of REE bioenergy internship programs.
- Sponsor training about bioenergy and bioeconomies for existing USDA and Cooperative Extension staff.
- Establish a scientist exchange program (e.g., among ARS, DOE, and university partners).



GLOSSARY OF TERMS, ABBREVIATIONS, AND ACRONYMS

ABBREE Council – Agricultural Bioenergy Bioproducts Research Education and Economics Council advises the Office of the REE Under Secretary in the area of bioenergy

Agricultural Energy Efficiency – Reducing the energy footprint of agricultural production (reducing inputs such as fertilizer, pesticide)

ARS – USDA's Agricultural Research Service

BBCC – Biobased Products and Bioenergy Coordination Council. The BBCC was established by the Secretary of Agriculture to provide a forum through which USDA agencies will coordinate, facilitate, and promote research, development, transfer of technology, commercialization, and marketing of biobased products and bioenergy, using renewable domestic agricultural and forestry materials. This includes promoting information sharing, strategic planning, and providing policy advice to the Secretary.

BEAD – BioEnergy Awareness Day

Biobased Products – Products determined by the Secretary to be a commercial or industrial product (other than food or feed) that is composed, in whole or significant part, of biological products or renewable domestic agricultural materials (including plant, animal, and marine materials) or forestry materials. For the purposes of this document, biobased products will be limited to substitutes for fossil-based products and to coproducts derived in connection with the conversion of biomass to fuel.

Bioeconomy – In the context of this document, “bioeconomy” is defined as economy where the raw materials and energy for industry are derived from biomass.

Biofuels – Fuels from renewable biological sources (see feedstocks) that provide energy for transportation, heating, industrial power requirements, and electricity. Biofuels include, but are not limited to, ethanol; butanol, methane, and biodiesel; hydrocarbons; hydrogen; and combustible materials (e.g., agricultural or forest waste).

Bioenergy – Energy produced from any form of biomass (e.g., heat, electricity, and liquid/solid/gaseous fuels)

Biomass – Any organic matter that is available on a renewable or recurring basis (excluding old-growth timber), including food and feed crops, dedicated energy crops and trees, agricultural residues, wood and wood wastes and residues, aquatic plants, grasses, other residues, fibers, and animal wastes, municipal wastes, and other waste materials.

Biomass Research and Development Board – Co-chaired by DOE and USDA, the board is responsible for coordinating Federal activities for the purpose of promoting the use of biobased industrial products.

The Biomass Research and Development Technical Advisory Committee – Is responsible for providing guidance to the Biomass Research and Development Board on the technical focus of the Biomass Research and Development Initiative.

Biorefinery – Converts agricultural feedstocks into energy and biobased products.

Certification Systems – Agriculture-based production systems that are standardized to promote good stewardship of the environment and rural communities, and that are economically feasible. An example is the Forestry Stewardship Council (FSC) certification program, which certifies that a forest complies with the internationally agreed FSC Principles of Responsible Forest Management. Another example is USDA's BiopREFERRED Program, which will certify products as biobased if products meet specific requirements for biobased content and environmental, economic, and human health effects over a product's life cycle.

Cooperative Extension System – A partnership of the USDA — through CSREES — with the Nation's land-grant universities to deliver science-based educational programs to the public. The partnership extends to the local level through county and city government participation.

GLOSSARY OF TERMS, ABBREVIATIONS, AND ACRONYMS

CSREES – USDA’s Cooperative State Research, Education, and Extension Service

DOE – Department of Energy. Two offices work on renewable energy: the Office of Science and the Office of Energy Efficiency and Renewable Energy.

Energy Conservation – Using less energy for a specific task

Energy Council – One of several committees that coordinate energy-related activities within USDA. The Energy Council examines departmental programs and authorities, ensuring they fit into a comprehensive energy strategy.

Energy Efficiency – Programs aimed at reducing the energy used by specific end-use devices and systems, typically without affecting the services.

EPA – Environmental Protection Agency. The EPA Office of Research and Development works on energy-related issues.

ERS – USDA’s Economic Research Service

- **Feedstocks** – Feedstocks refer to materials that provide the biomass for conversion to bioenergy. Feedstocks are diverse. The following list of feedstocks is from the National Biofuels Action Plan Workshop Summary Report (<http://www.biofuelspostureplan.govtools.us/documents/NationalBiofuelsActionPlanWorkshopSummaryReportFinal-5-30-07.pdf>)

- **Agricultural Residues**

- Corn stover, various straws and hulls, bagasse, orchard prunings

- **Forestry**

- Residues (logging slash, forest thinnings, fuel reductions, understory brush) and pulping process wastes (e.g., black liquor, other wastes)
- Conventional (e.g., Southern pine)

- **Dedicated Energy Crops**

- Starch-based (e.g., corn, grain sorghum)

- Sugar-based (e.g., sugarbeet, sweet sorghum, sugarcane)
- Oil crops (e.g., soybeans, canola, other minor oilseeds) and other oils (microalgae)
- Lignocellulosics
- Herbaceous (e.g., alfalfa, reed canary grass, switchgrass, large grass)
- Short-rotation Woody Crops (e.g., poplar, willow)

- **Other Wastes**

- Industrial (includes food processing)
- Domestic wastewater
- Animal wastes
- Construction/demolition
- Yard waste
- Biosolids (wastewater treatment sludge)
- Waste oils
- Disposal method for invasive species

Implementation Group – Technical group of qualified experts comprised primarily of USDA employees identified and charged under the National Team with supporting sustainable regional integrated bioenergy development by working with regional implementation teams.

Integrated Systems Approach – Multidisciplinary process for developing products and processes combining systems analysis, technical design, assessment tools, implementation, and integrated management data.


Land-Grant University System – Land-grant universities provide research, education, and extension services through unique relationships provided for in their founding legislation.

NAL – National Agricultural Library (part of ARS)

NAREEEAB – National Agricultural Research Extension Education Economics Advisory Board

NASS – USDA’s National Agricultural Statistics Service

Natural Resource-based Energy – Energy produced from forest biomass (including residues), wind, and solar sources (REE has only a small portfolio of wind and solar energy projects).



NCFAP – National Center for Food and Agricultural Policy

Other Federal Agencies – Non-USDA agencies involved with bioenergy (e.g., DOE, EPA, National Science Foundation [NSF], Department of Transportation [DOT], Department of the Interior [DOI], Department of Defense [DOD])

Other USDA Agencies – Non-REE agencies involved with bioenergy (e.g., Forest Service [FS], Natural Resources Conservation Service [NRCS], Office of the Chief Economist [OCE], Rural Development [RD], Farm Service Agency [FSA])

PSA – Public Service Announcement

RD – USDA’s Rural Development Mission Area

REE – Research, Education, and Economics Mission Area (comprised of ARS, CSREES, ERS, and NASS)

Regional Production System – Bioenergy production continuums that serve specific regions

Renewable Energy – Resources that constantly renew themselves or that are regarded as practically inexhaustible. These include solar, wind, geothermal, hydro, and wood. Although particular geothermal formations can be depleted, the natural heat in the Earth is a virtually inexhaustible reserve of potential energy. Renewable resources also include some experimental or less-developed sources such as tidal power, sea currents, and ocean thermal gradients.

Scalable Technologies – Technologies that are commercially viable at relatively small scales (e.g., on-farm)

SAES – State Agricultural Experiment Stations System is comprised of agricultural experiment stations in each State.

Sun Grant Initiative (SGI) – Is a national land-grant program authorized to conduct research, education, and extension programs to support the development of a biobased economy. The SGI facilitates communication and coordination

between the Departments of Agriculture and Energy to broaden the responsibilities of land-grant institutions beyond traditional agricultural issues. Through, development, distribution, and implementation of biobased energy technologies, the SGI enhances national energy security; promotes diversification and environmental sustainability; and promotes biobased economic diversification in rural communities.

Sustainability – The term “sustainable agriculture” (U.S. Code Title 7, Section 3101) means an integrated system of plant and animal production practices having a site-specific application that will over the long term:

- Satisfy human food and fiber needs.
- Enhance environmental quality and the natural resource base upon which the agricultural economy depends.
- Make the most efficient use of nonrenewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls.
- Sustain the economic viability of farm operations.
- Enhance the quality of life for farmers and society as a whole.

Systems Approach – A holistic approach that recognizes the need to include and examine the connections and interactions between the different components that comprise a system so that all the impacts of any changes in one or more components can be understood.

Whole Life Cycle Assessment – Life cycle assessment (LCA) is a process for analyzing the environmental impacts generated over the entire life cycle of a product — from provision of raw materials to final disposal of the product.



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