

Food Systems, Energy and Climate Change

The 103 land-grant universities across the United States have a rich history of solving some of the most vexing problems facing our nation, bringing those solutions to those that need them most, and teaching new generations in emerging disciplines which will enable them to address the problems of the future. As Congress develops legislation to address the impacts of a changing climate, America's land-grant universities have developed a comprehensive plan to address specific areas in the legislation. Five compelling proposals to address issues related to agriculture, energy and climate change through research, extension and education are presented below.

I. Regional Climate Response, Food and Energy Security Institutes

Establish four regional Institutes which would foster multistate collaboration linking global science with local and regional needs to develop, deliver and foster adoption of information and decision support products that would be developed in partnership with appropriate stakeholders on issues related to climate, food and energy security.

II. Climate Change and Agriculture

Establish competitive grants programs to address issues related to climate change and agriculture research, extension and education in the areas of:

A. Sustainable food, fuel and fiber systems. The last five years witnessed extreme volatility of global agricultural commodity and petroleum prices and the rapid emergence of biofuels as a potential supply-side solution. The world is experiencing diminishing water resources and arable land, declining soil quality and environmental degradation, droughts, and increasing climate change, all of which have affected global agricultural productivity.

Exacerbating these crises is global climate change that is not only affecting agricultural production, but is resulting in the spread of non-native, invasive pests affecting humans, animals and plants in all regions of the world, including the U.S.. These challenges will contribute to new challenges that threaten global food security.

The solution to these problems is a renewed green revolution, a *biocentury initiative*, which encourages sustainable development and will require innovative partnerships and collaborations among academia, industry, and the government. This initiative will reflect solution-oriented green research, development, deployment, and education with unprecedented national economic, environmental, and social benefits.

This Initiative will catalyze discovery of new knowledge involving the complex issues surrounding the conversion of biomass, from farm and non-farm sources, into a range of clean, safe and renewable necessities, including fuels, energy and chemicals while sustaining our Nation's food production capacity. These efforts will protect our nation's food, energy, bioproducts, and environmental security, while adding value to the agricultural enterprise.

Critical focus areas that need immediate attention include:

- Develop new knowledge and tools to remove the scientific, technical, economic, and policy gaps that currently impede the promise of renewable agricultural resources to meet the food, fuel, feed, and fiber needs of the world;

- Develop sustainable energy systems and next generation biofuels that are in harmony with food and environmental systems;
- Develop and test new plant and animal varieties that are adapted to diverse soils, water, and climate conditions, result in globally sustainable production methods meet global food and marketing demands, enhance nutrition and reduce chronic diseases and other specific health conditions;
- Compile and analyze information available from the network of long-term, controlled-research, extension and education centers to determine locations and environments suitable of sustained agriculture productivity;
- Provide solutions for food-related health challenges;
- Assist agriculture and forestry producers in making efficient land use decisions,
- Assist producers in adopting new plant and animal varieties;
- Identify factors important to and engage citizens in the development of effective sustainability policies that promote resilience in communities and natural systems; and
- Encourage food practices that promote a healthy lifestyle.

B. Global Climate Change. As global climate patterns shift, the kinds and distribution of endemic pests and diseases will change, and many habitats will become more susceptible to new threats. To ensure the sustainability of the country's food production system, we must constantly update the exclusion, detection, eradication, and control of invasive pests and diseases. The threat of endemic and invasive pests and diseases is enormous in economic terms with direct and indirect costs to the agriculture and livestock industries reaching more than \$138 billion per year in recent years. Human health threats associated with pest and disease organisms are also of serious concern. Critical focus areas that need immediate attention include:

- Develop innovative technologies for rapid identification through surveillance and detection systems,
- Increase knowledge of invasion biology to better assess risk, prediction and intervention,
- Develop effective and economical technologies and tactics to mitigate or control organisms for reduced environmental impact and health threats,
- Develop capacity to predict how changing environments influence the emergence of endemic pests and diseases and the introduction of new species and vectors,
- Provide training in the use of technologies for surveillance and detection and rapid identification of pests and diseases, and
- Assist producers and other landholders in making decisions and implementing practices that lead to more effective prevention of invasive pests and in the use of environmentally friendly mitigation and control measures.

C. Water. Understanding how climate change affects water quality, quantity, seasonality, and predictability is critical to maintaining and enhancing agriculture productivity and ensuring a reliable food supply.

Critical focus areas that need immediate attention include:

- Develop and advance adoption of innovative scientific techniques, products and/or processes to improve water use efficiency and water conservation management practices;
- Genetically improve crops to increase yields, introduce novel traits, and adapt plants to water-limited conditions;

- Develop and deploy flexible and effective water policies and strategies to adapt to declining quantities and less reliable sources of water;
- Invent new methods and technologies to use degraded, poor quality water in producing safe, high quality food;
- Educate and advise on using effective water conservation techniques and practices;
- Educate and advise protecting and improving water quality, particularly on farm and ranch land and on public and private green spaces; and
- Engage citizens in effective water policy development.

III. Energy and Climate Extension

Create an Energy and Climate Extension Initiative (ECEI) that would provide a modern information education system and nationwide network of Energy and Climate Extension Advisors/ Educators. These Extension specialists would work on issues related to energy conservation, efficient use and renewable energy production and related climate change concerns important to all communities. This would ensure that research findings and new knowledge is made readily available to the citizenry in forms that are easily applied and adopted. The targeted audiences would include the general public, homeowners, landowners, small business, agricultural producers, local government, communities and community leaders. The Energy Extension Initiative would build on the strengths of the existing Cooperative Extension Service including its connection to the nation's land-grant universities and its proven network of trusted local level educators.

Critical focus areas that need immediate attention are:

- Relationship Between Carbon Emissions and Energy Types, Land Use and Climate Change;
- Understanding Energy Systems and Renewable Energy Sources;
- Biofuels and Bioeconomy Systems Support;
- Energy Education Program for Youth and Adults;
- Demonstration of Efficient Energy Use and Conservation;
- Energy Development and Climate Policy Impacts on Landowners and Rural Communities; and
- Strengthen youth discovery, interest, and career/workforce development in science, engineering and technology through strong 4-H educational and engagement programs.

IV. Forest Management and Mitigation of Elevated Atmospheric CO₂.

National governments worldwide are committed to mitigating rising atmospheric CO₂ through programs, such as cap-and-trade, designed to reduce fossil fuel CO₂ emissions, and enhance biological uptake and storage of CO₂ by natural and managed ecosystems. Forest ecosystems will be critical to these carbon offset programs: annual uptake and storage of CO₂ by forests already offsets 11 to 16% of U.S. greenhouse gas emissions, and the potential for greater carbon mitigation exists through the application of existing and emerging forest management technologies.

Create a competitive research, extension and education initiative to address pressing problems related to the use of forests and natural resource management as tools to mitigate atmospheric CO₂.

Critical focus areas requiring immediate attention include:

- Develop and encourage adoption of optimum forest management regimes for sequestering carbon in U.S. forests, including system-level biological, ecological, and economic assessment of the use of varying rotation length, thinning, prescribed fire regimes, and improved tree varieties with enhanced carbon fixation capacity;
- Develop and deploy economically and ecologically sustainable forest management systems, including breeding and deployment of genetically improved varieties as well as policy obstacles to the deployment of genetically modified species, to produce carbon-neutral biofuels to substitute for fossil fuels;
- Create efficient methodologies for cost effective implementation of cap-and-trade systems;
- Evaluate the vulnerability of existing forest ecosystems and forest management systems to predicted climate fluctuations and changes;
- Assess the feasibility and efficacy of using reduced emissions from deforestation and forest degradation (REDD) approaches to CO₂ mitigation;
- Conduct life-cycle analyses with full-cost accounting of alternative policies, incentives and management regimes for biofuels, carbon offset systems and cap-and trade programs, including analysis of regional-to-global ecological and economic consequences of scenarios;
- Provide information to landholders and local policy makers that enable effective decision making related to land management and CO₂ mitigation;
- Assist landowners in adopting technologies that reduce carbon emissions through appropriate energy use including improved equipment and energy-based inputs;
- Assist landowners in adopting technologies that can capture carbon credits through carbon sequestration;
- Assist landowners in utilizing carbon markets and carbon trading to enhance their income opportunities;
- Assist landowners and local businesses in implementing renewable energy technology;
- Educate individuals and encourage the use of tax incentives for purchase and use of energy efficient equipment for operation, transportation and other technology adjustments; and
- Educate agricultural organizations and policy makers on key public policy discussions (e.g. climate change, biofuels development and un-intended consequences).

V. Human Capacity Development for Climate Change, Food and Energy Initiative

The development of human intellectual capital to satisfy future workforce needs to meet the challenges of energy and climate change require a steady supply of qualified graduates educated in fundamental and applied principles and technologies within the context of energy and climate change. These include the implementation of creative, relevant curricula; opportunities for independent and authentic research experiences of pre-college, undergraduate and graduate students; engagement of diverse and talented students; and programs dedicated to further enhancing the education of employed individuals and re-training of displaced workers.

While immense resources are being invested in research and development of energy and climate technologies, an increased investment in human capital for these fields is imperative to implementing those technologies.

Create specific programs to address human capacity development by allocation of resources to:

- Develop and transform curriculum to reflect the interdisciplinary thinking required for addressing energy and climate change issues;
- Supplement competitive research grants in AFRI for dedicated support of undergraduates and high school students in authentic research experiences;
- Engage the diversity of the total pool of human capital by recruiting and retaining/engaging undergraduates and high school students from under-represented populations as these populations are likely to feel the effects of climate change disproportionately while have fewer resources to deal with such changes;
- Prepare future PhD level faculty to meet the increased national needs for human capacity development in the fields of energy and climate change; and
- Develop programs to re-train workers and to enhance the education of employed individuals, in partnership with community colleges, distance education initiatives, and industries, to grow the human intellectual capital of the new green economy.