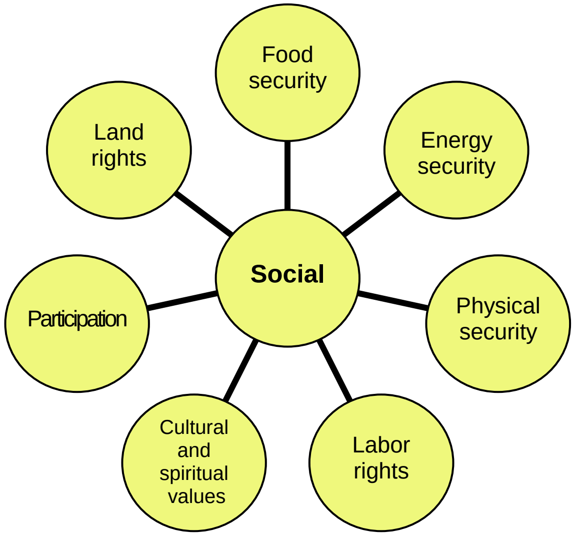
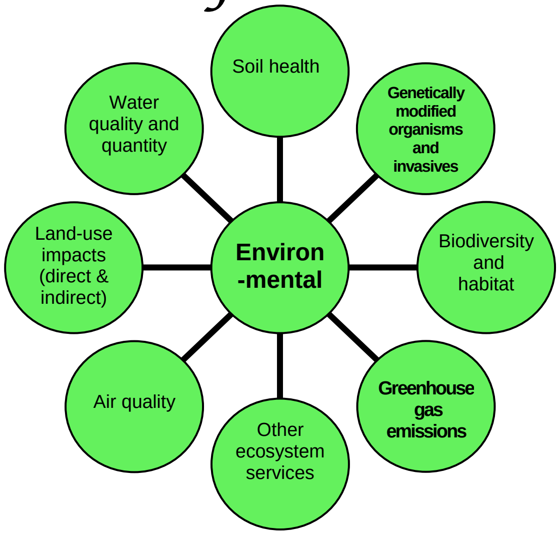
Sustainability has social, economic, and environmental components



Social aspects include following applicable laws and international treaties; using open and transparent participatory processes that actively engage relevant stakeholders, establish rights and obligations, and emplace a long-term sustainability plan with periodic monitoring; and ensuring decent wages and working conditions, the safety of workers, and workers' rights to organize and collectively bargain. They also consist of preserving the livelihood of residents and their affordable access to staple crops; fair methods for establishing ownership and land use that equitably compensate the indigenous population for land acquisitions and relinquishments of rights; guaranteeing the reliability of the energy supply that supports the local society and economy; and protecting the safety of people, facilities, and regions. Social aspects of sustainability recognize and preserve the wisdom of all cultures based on multifaceted, intergenerational ties to the land.

Economic aspects include coping with limited land resources; existing and emerging feedstocks; technical advances; and different feedstocks' having different biological characteristics, resource requirements, and costs of production and transport. This perspective recognizes the vagaries of production decisions (which are driven by the expected price for a crop, the anticipated costs of production, and cropping practices) and the potential for coproducts that enhance economic benefits and make production more attractive. It also addresses transport costs' influencing supply, demand, and prices and the possibility of the distortion of markets for animal feed, food, and processed-food ingredients. Economic factors are influenced by government policies, technology, energy and feedstock prices, demand resulting from diverse energy uses and environmental consequences.



Environmental aspects include services that are provided by prevailing ecological conditions such as soil, water, and air quality; biodiversity; plant and wildlife habitat; storm-water protection; and the soil health. In addition, the greenhouse gas emissions (or, conversely, carbon sequestration) resulting from energy decisions can have a strong effect on atmospheric carbon concentrations and thus on changes in climate conditions. Bioenergy choices can also have direct influences on local land-use changes as well as reputed indirect effects (e.g., the use of farmland to produce energy crops can displace traditional crops, causing land clearing to produce those crops elsewhere). Finally, environmental implications include the potential of bioenergy crops spreading genetically modified organisms, invasive species, or nonnative species; displacing heritage species; and altering the range and magnitude of ecological services provided. A sustainable approach to bioenergy can alleviate such impacts and enhance benefits.

History

Oak Ridge National Laboratory (ORNL) has a long and rich tradition of interdisciplinary research. In the 1950s, environmental science was first explored at ORNL through the integration of chemistry, plant and animal biology, geology, and atmospheric sciences to study the ecology of organisms, communities, and landforms.

ORNL researchers have been performing analyses of biofeedstock options and the development of dedicated bioenergy crops for the past 30 years. In addition, researchers at ORNL have developed internationally well-known capabilities and tools for analyses of transportation systems and fuels, including biofuels. Many seminal contributions by these experts have formed the basis for decision making at the national and international levels, as evidenced most recently by the *Billion Ton Study*, which explored sustainably producing one billion dry tons of biomass feedstock per year in the United States.

ORNL ecologists, social scientists, and geographers document and explore the processes responsible for land-use change and implications of those changes. Using high-performance computing, geospatial analysis, and advanced visualization, ORNL scientists deal with computational, data, and geographic concerns underlying sustainability for bioenergy.

This research portfolio is supported by the Department of Energy, Environmental Protection Agency, National Aeronautics and Space Administration, and Department of Agriculture.

Research opportunities

- Bioenergy options from a systems perspective
- Sustainability as a combination of environmental, economic, and social concerns
- Appropriate scales for addressing bioenergy sustainability concerns
- Tradeoffs in implications of land-use and land-management decisions
- Quantifying environmental, economic, and social implications of bioenergy choices at local, regional, and global scales
- Lignocellulosic feedstock options and their implications for ecosystem services and social and economic benefits
- Sustainability metrics

Events and programs

- Two national or international workshops per year at or near ORNL
- Weekly informal information exchanges
- Monthly luncheon seminars

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Oak Ridge National Laboratory

CBES

Center for BioEnergy Sustainability

Bringing people together to enable a sustainable bioenergy future

The objective of the CBES is to use science and analysis to understand the sustainability (environmental, economic, and social) of current and potential future bioenergy production and distribution; to identify approaches to enhance bioenergy sustainability; and to serve as an independent source of the highest-quality data and analysis for bioenergy stakeholders and decision makers.

CBES involves ORNL scientists in systems biology, bioenergy science, biochemical engineering, national and global bioenergy analysis, resource economics, transportation, logistics modeling, spatial data analysis and modeling, and environmental effects.

CBES explores bioenergy sustainability by

- Exploring the systems context in which energy decisions are made
- Conducting field, laboratory, and modeling experiments to assess bioenergy options
- Testing, calibrating, and determining the sensitivities and uncertainties of models and their projections
- Assessing the data used to characterize bioenergy options
- Identifying metrics
- Communicating scientific results