



U.S. DEPARTMENT OF
ENERGY

Energy Efficiency &
Renewable Energy

DOE Perspectives on Sustainable Bioenergy Landscapes

Green Lands Blue Waters 2014 Conference
November 19, 2014

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DOE Bioenergy Technologies Office

Objective: Through targeted research, development, and demonstration (RD&D), enable sustainable, nationwide production of advanced biofuels that will displace a share of petroleum-derived fuels, mitigate climate change, create American jobs, and increase U.S. energy security.

Research, Development, and Demonstration at Increasing Scale

Feedstock Supply

Develop sustainable and affordable feedstock supply and efficient logistics systems.



Conversion R&D

Develop commercially viable technologies for converting feedstocks into liquid transportation fuels and products.



Demonstration at Increasing Scale

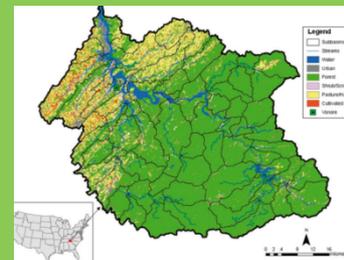
Validate integrated technologies at cost-shared pilot, demonstration, and pioneer scale facilities.



Cross Cutting

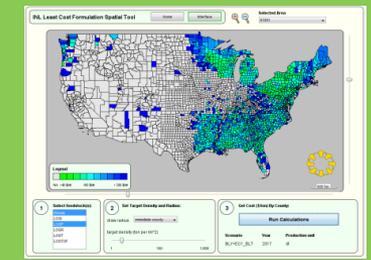
Sustainability

Promote the positive economic, social, and environmental effects of bioenergy.



Strategic Analysis

Conduct market, policy, environmental, and other analyses to inform planning and decisions.



Commitment to Sustainability

Strategic Goal: to understand and promote the positive economic, social, and environmental effects and reduce the potential negative impacts of bioenergy production activities.



What is a “sustainable bioenergy landscape”?



Executive Order 13514 defines *sustainable*:

To create and maintain conditions under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic, and other requirements of present and future generations.

Principles of Landscape Design

Landscape design is a plan for resource management.

- Considers local context
- Engages stakeholders throughout process
- Conserves priority natural and social functions
- Monitors key measures of sustainability
- Adjusts management to improve over time



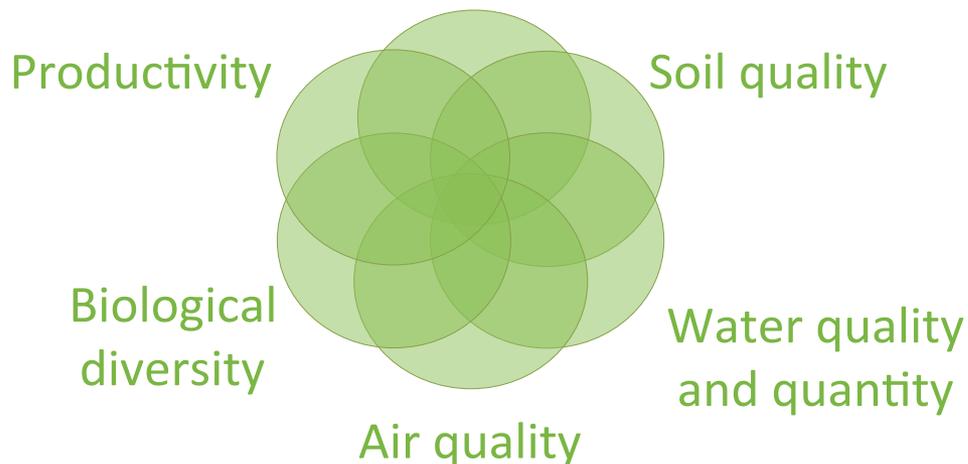
ORNL

Landscape design pertains to multiple spatial scales.

sub-field → farm scale → watershed → region

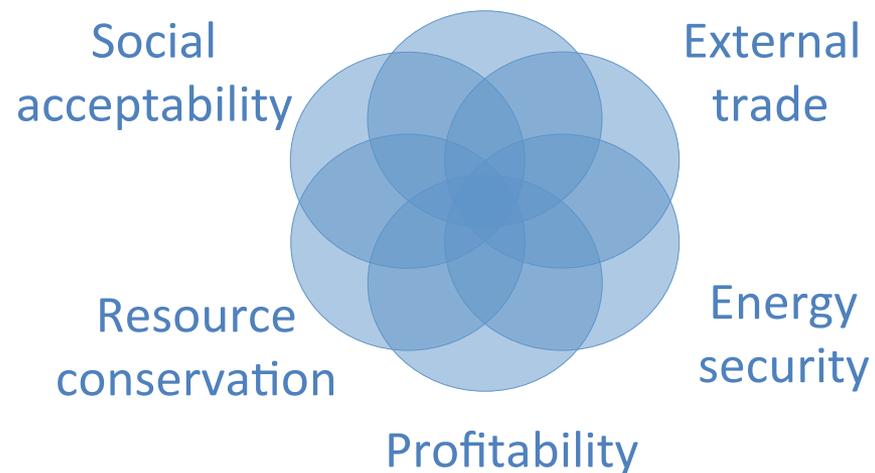
Categories for Sustainability Indicators

Greenhouse gas emissions



McBride et al. (2011) *Ecological Indicators* 11:1277-1289.

Social well being



Dale et al. (2013) *Ecological Indicators* 26:87-102.

Recognize that measures and interpretations are context specific

[Efroymsen et al. (2013) *Environmental Management* 52:291-306]

DOE-Supported Projects on Landscape Design

2010 Solicitation

“Development of Methodologies for Determining Preferred Landscape Designs for Sustainable Bioenergy Feedstock Production Systems at a Watershed Scale”

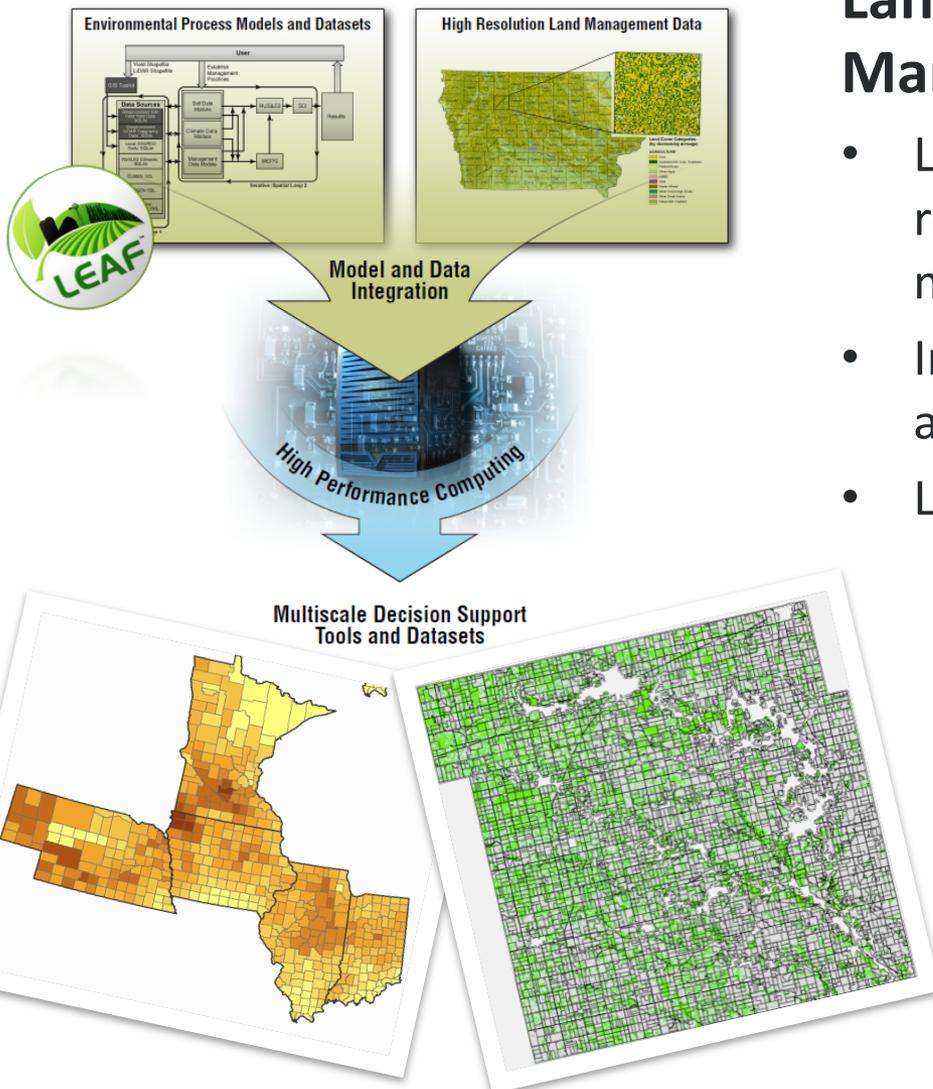
Projects Selected

- “Optimization of Southeastern Forest Biomass Crop Production”
- “Watershed Scale Optimization to Meet Sustainable Cellulosic Energy Crop Demand”
- “Pathways Toward Sustainable Bioenergy Feedstock Production in the Mississippi River Watershed”

Key Accomplishments to Date

- Field research and empirical data on bioenergy crop production and environmental impacts
- Enhanced models and approaches for spatial optimization and assessing potential watershed-scale impacts





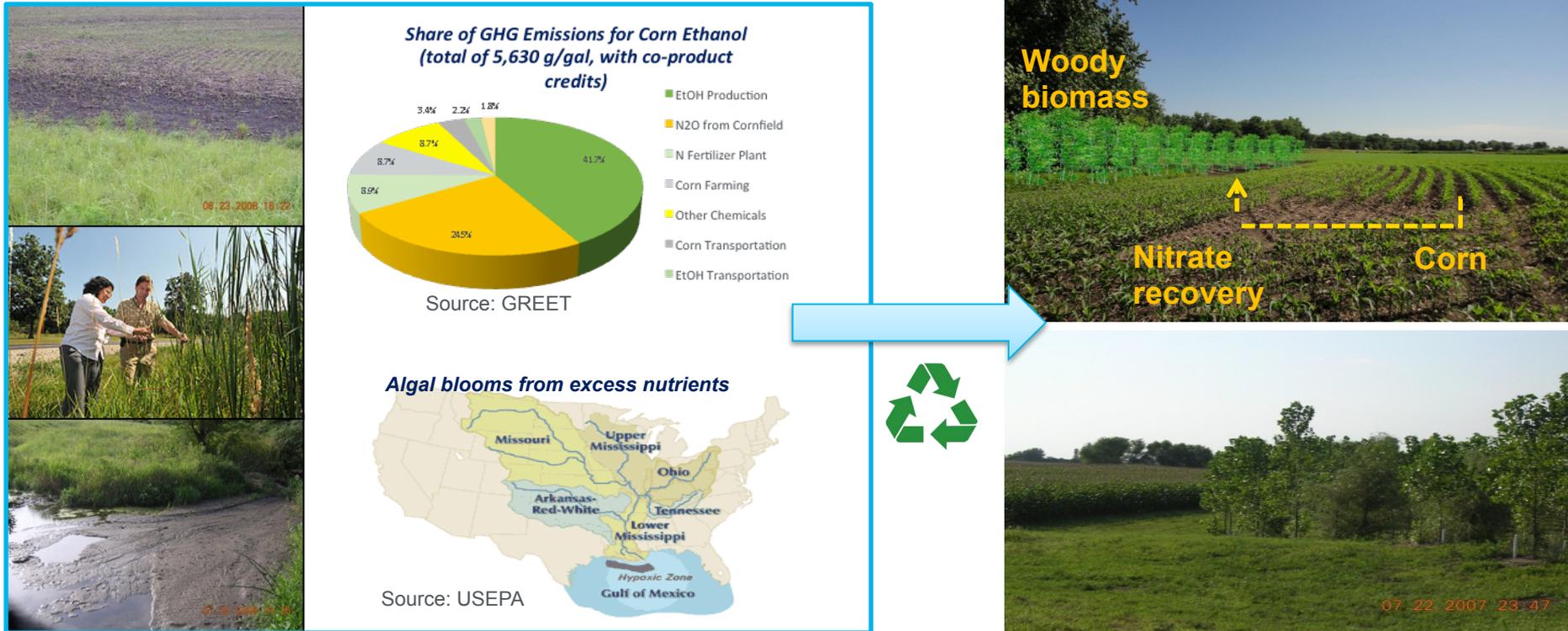
Landscape Design Utilizing Subfield Management Decisions

- Local, regional, or national assessments of resource availability & alternative management solutions
- Increase production of food, feed, fiber, and fuel from our lands
- Leverage subfield variability to:
 - Improve sustainability & diversity
 - Increase profitability
 - Increase biomass availability

Sources: Muth et al (2012) doi:10.1016/j.apenergy.2012.07.028
Bonner et al (2014a) doi: 10.1007/s12155-014-9423-y
Bonner et al (2014b) doi:10.3390/en7106509

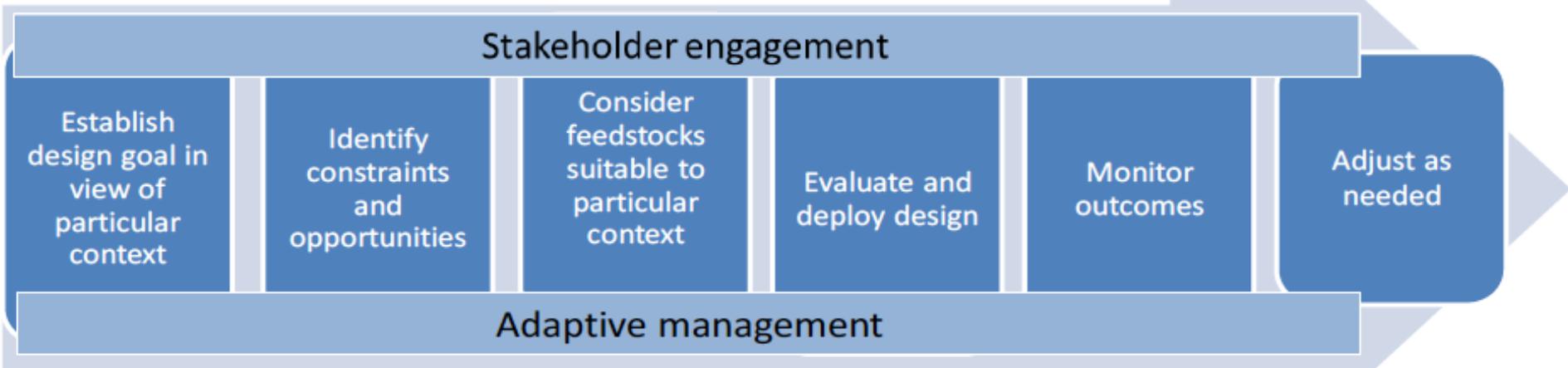
Biomass Production and Nitrogen Recovery

- Applying resource recovery principles to biomass production



PI: Cristina Negri, Argonne National Laboratory

ORNL's Landscape Design Approach to Assess Sustainability of Wood-Based Bioenergy



DOE Workshops on Landscape Design

Incorporating Bioenergy into Sustainable Landscape Designs

Two workshops exploring the science and practice of bioenergy landscape design

Workshop 1- March 2014, New Bern, NC

- Focus on woody/forestry systems
- Organized by ORNL and NCASI

Workshop 2- June 2014, Argonne, IL

- Focus on Midwest/agricultural systems
- Organized by ANL

Workshop agendas, presentations, and other materials:

- <https://bioenergykdf.net/content/incorporating-bioenergy-sustainable-landscape-designs-workshop>
- <http://web.ornl.gov/sci/ees/cbes/workshop.shtml>



RFI on “Landscape Design for Sustainable Bioenergy Systems”

- DOE Request for Information (RFI) released August 18, 2014
- Sought input on key barriers, considerations, and R&D needs

Question Categories

- 1) Approaches for Integrating Cellulosic Bioenergy Feedstocks into Existing Agricultural and Forestry Systems
- 2) Experimental Methods for Assessing Environmental Sustainability Indicators
- 3) Data and Analysis Needs for Understanding Logistic Systems and Costs
- 4) Possible Projects for Testing Landscape Design Approaches for Bioenergy

Source: [DE-FOA-0001178, Request for Information \(RFI\) on Landscape Design for Sustainable Bioenergy Systems](https://www.energy.gov/foia/foia-0001178)

RFI Responses: Needs Identified

- More holistic partnerships and integrated assessments across environmental, economic, and social dimensions
- Larger on-the-ground studies to
 - ✓ test landscape design approaches
 - ✓ generate needed empirical data
 - ✓ assess impacts of cellulosic feedstock production at the watershed or comparable scale

Source: [DE-FOA-0001179: LANDSCAPE DESIGN FOR SUSTAINABLE BIOENERGY SYSTEMS](#)

RFI Responses: Needs Identified

- Cost-effective sampling and analysis techniques to assess landscape-scale impacts
- Improved understanding of feedstock logistic systems and costs
- Enhancement of existing tools and frameworks so they
 - ✓ apply to cellulosic feedstocks
 - ✓ are calibrated and validated with empirical data
 - ✓ are integrated into actionable tools for decision-making, particularly bridging scales from sub-field to larger areas

Source: [DE-FOA-0001179: LANDSCAPE DESIGN FOR SUSTAINABLE BIOENERGY SYSTEMS](#)

RFI Responses: Recommendations for R&D Projects

- Engage landowners and businesses and include diverse public and private partnerships
- Involve local experts to consider biodiversity and the needs of wildlife
- Enable community and local stakeholders to evaluate and prioritize goals and trade-offs
- Allow time for crop establishment, science-based monitoring, and adaptive management (3-7 years)
- Make use of existing field sites
- Make resulting datasets and tools publically available for other researchers, business, and landowners

Source: [DE-FOA-0001179: LANDSCAPE DESIGN FOR SUSTAINABLE BIOENERGY SYSTEMS](#)

Landscape Design Announcement

Landscape Design Funding Opportunity Announcement— Announced on October 20, 2014

- DOE announced up to \$14 million to support landscape design approaches that maintain or enhance the environmental and socio-economic sustainability of cellulosic bioenergy through the improvement of feedstock production, logistics systems, and technology development.

• **Concept Papers Due: 11/21/2014**

• **Full Applications Due: 1/12/2015**

Full FOA information is available on the [EERE Exchange](#).





Consider bioenergy within a system as an opportunity to design landscapes that add value