Introduction: Analysis & Sustainability (A&S)

- The Team
- Goals & Objectives
- Challenges
- Approach & Partnerships
- Budget
- Key Accomplishments
- Future Directions
- Upcoming Activities
Introductions: Analysis & Sustainability Staff

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Analysis & Sustainability: Critical to BETO’s Mission

Proactively addresses issues that affect the scale-up potential, public acceptance, and long-term viability of the Office’s technology investments.

Equips DOE with analyses and expertise to inform national and global dialogues on the benefits and impacts of bioenergy.
Goals and Objectives

**Strategic Analysis**

Provide context and justification for decisions at all levels by establishing the basis of quantitative metrics, tracking progress toward goals, and informing portfolio planning and management.

**Cross-Cutting Sustainability**

Understand and promote the positive economic, social, and environmental effects and reduce the potential negative impacts of bioenergy production activities.
Dimensions of Bioenergy Sustainability

Economic Sustainability
- Commercial viability
- Return on investment
- Net present value
- Process efficiency
- Output of desired products

Social Sustainability
- Social acceptability
- Social well-being
- Energy security and external trade
- Rural development and workforce training

Environmental Sustainability
- Climate
- Soil quality and agronomics
- Water quality and quantity
- Air quality
- Biological diversity
- Land Use
A&S Plays a Cross-cutting Role

A&S Projects

- Standardized methods and analytical approaches
- Practical tools, models, and best practices
- Analyses on potential impacts and strategies for beneficial outcomes

Role of Analysis & Sustainability
A&S Plays a Cross-cutting Role

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Role of Analysis & Sustainability

Program-wide Interface
- Data and analysis on environmental and economic performance
- Sharing of findings and best practices

- FSL
- Algae
- Conversion
- DMT
A&S Plays a Cross-cutting Role

Analytical basis for strategic planning, decision-making, and assessment of progress to support BETO, EERE, and DOE goals

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Intra- and inter-agency coordination, stakeholder engagement, and international dialogues

Conversion
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Key Challenges

Challenges and Barriers

- Limited quantification of economic, environmental, and social benefits and impacts of bioenergy
- Lack of comparable, transparent, and reproducible analysis
- Limitations of analytical tools for decision-making
- Nascent nature of sustainability best practices
- Lack of consensus, data, and proactive strategies for addressing land use impacts
Key Activities and Partners

Key Activities

- Models and tools
- Analyses
- Landscape Design
- Communication and Collaboration
- International Dialogues
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- Models and tools
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Models and tools:
- Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET)
- Water Assessment Tool for Energy Resources (WATER)
- Biomass Scenario Model (BSM)
- Landscape Environmental Assessment Framework (LEAF)
- Jobs & Economic Development Impact (JEDI)
- Soil & Water Assessment Tool (SWAT)
A&S: Key Activities and Partners

Key Activities

- Models and Tools
- Analysis
- Landscape Design
- Communication and Collaboration
- International Dialogues

Techno-economic analysis
Land-use change
Economic and security benefits
Lifecycle assessments
Environmental and socio-economic impacts
Synergies and trade-offs
Best practices
A&S: Key Activities and Partners

Key Activities

- Models and tools
- Analysis
- Landscape Design
- Communication and Collaboration
- International Dialogues

Spatial optimization
Watershed modeling
Field research
Best management practices (BMPs)

Partners:
- Argonne National Laboratory
- Oak Ridge National Laboratory
- Idaho National Laboratory
- Purdue University
- NC State University
- Bio & Ag Engineering
- Weyerhaeuser

Energy Efficiency & Renewable Energy
U.S. Department of Energy
A&S: Key Activities and Partners

Key Activities:
- Models and tools
- Analysis
- Landscape Design
- Communication and Collaboration
- International Dialogues

Partners:
- Federal agencies
- Non-profit organizations
- Environmental community
- EERE Sustainable Transportation Offices
- DOE Office of Science
- DOE ARPA-E
A&S: Key Activities and Partners

Key Activities

- Models and tools
- Analysis
- Landscape Design
- Communication and Collaboration
- International Dialogues

Global Bioenergy Partnership
International Energy Agency – Bioenergy
Roundtable on Sustainable Biomaterials
International Standards Organization
Other multi-national partnerships
Annual budget about $11 M
- Strategic Analysis
- Cross-cutting Sustainability

Currently 29 projects
- 25 national lab projects
- 4 academic/industry projects
  (existing competitive projects not funded by A&S)
Key Accomplishments

Enhanced widely used tools and models

- GREET.net 2014
- Biomass Scenario Model (BSM) on KDF
- WATER 3.0 2015
- Simulation of bioenergy crops and ag residue in SWAT model (Purdue)
- Suite of Jobs and Economic Development Impact (JEDI) models
Key Accomplishments

Increased integration of techno-economic and environmental analyses

• Design cases of biofuel pathways
  • Environmental sustainability metrics for conversion stage
  • GREET analysis of full pathway to identify drivers of GHG emissions
    – Corn stover to ethanol via fermentation
    – Southern pine to ethanol via gasification
    – Hybrid poplar to renewable gasoline and diesel by fast pyrolysis
    – Algae hydrothermal liquefaction
    – Additional pathways underway
  • Assessment of federal air pollutant emission regulations potentially applicable to a biorefinery (fast pyrolysis and sugars-to-hydrocarbons)
  • Estimates of maximum potential emissions of regulated air pollutants for a biomass depot (for fast pyrolysis and sugars-to-hydrocarbons biorefineries)

• Coordination between INL, NREL, PNNL, and ANL
  • Sharing data and results
  • Developing pathways in GREET and WATER models
Key Accomplishments

Developed innovative approaches to multi-attribute sustainability assessments

Applied LEAF to identify opportunities for energy crop production based on subfield-scale distribution of profitability
- Increase profit and productivity
- Reduce erosion and nitrate runoff
Developed framework for using indicators to assess progress toward bioenergy sustainability

- Uses Multi-Attribute Decision Support System (MADSS)
- Determines relative contributions of three “pillars” to overall sustainability
- Applied to bioenergy crop production system in East Tennessee
Key Accomplishments

Contributed to high-profile international dialogues and publications

- Intergovernmental Panel on Climate Change (IPCC)
- SCOPE Bioenergy & Sustainability Project: Bridging the Gaps
- Draft standard ISO13065, Sustainability Criteria for Bioenergy
  - Systematic methodology based on evidence
  - Measurable, reproducible, verifiable
  - Clarify accounting for fossil and biogenic carbon
  - Methods for detection of soil carbon change
  - Life-cycle assessment methods
Key Accomplishments

Continued field monitoring and testing of management practices

ANL: Nitrogen recovery by bioenergy crop buffer

ORNL-USFS: Intensive short-rotation pine management

3 instrumented watersheds

Intensive pine silviculture for bioenergy on 40% of Watersheds B and C (130 ha total; yellow shading on map).
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](https://bioenergykdf.net/content/incorporating-bioenergy-sustainable-landscape-designs-workshop)
Landscape Design for Sustainable Bioenergy Systems — 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.
Future Directions

- Further understand and document evolving markets of biofuels and bioproducts
- Continue work to develop and maintain analytical tools, models, methods, and datasets to advance the understanding of bioenergy and its related impacts
- Further integrate sustainability into strategic planning, goal setting, and techno-economic/state-of-technology assessments
- Communicate successes and findings on bioenergy sustainability to the public, other agencies, stakeholders, and international community
Upcoming Activities

- June 23 & 24, Bioenergy 2015
  - Plenary and break-out session on Sustainability

- Landscape Design Funding Opportunity Selection Announcement

- 2016 Billion Ton Update: Sustainability analysis
Peer Reviewers

- John Sheehan (Lead Reviewer) - Colorado State University
- Stephen Costa – U.S. Department of Transportation
- Jody Endres – University of Illinois at Urbana-Champaign
- Michael Shell – U.S. Environmental Protection Agency
- Candace Wheeler – General Motors