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BIOENERGY TECHNOLOGIES OFFICE

Social Aspects of Bioenergy Sustainability Workshop Report

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Social Aspects of Bioenergy Sustainability Workshop Report

A workshop summary report from the Social Aspects of Sustainability Workshop

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Executive Summary

The Department of Energy (DOE) Office of Energy Efficiency and Renewable Energy Bioenergy Technologies Office[1] held a workshop on "Social Aspects of Bioenergy" on April 24, 2012, in Washington, D.C., and convened a webinar on this topic on May 8, 2012. The workshop addressed questions about how to measure and understand the social impacts of bioenergy production. These needs arose from feedback given at the 2011 Program Peer Review.[2] The workshop was attended by representatives from DOE, national labs, the Environmental Protection Agency, United States Department of Agriculture, and several universities. The participants were enthusiastic that social aspects of bioenergy sustainability were being addressed and evaluated.

The workshop focused on a set of social sustainability indicators for bioenergy that were developed by Oak Ridge National Laboratory. The proposed indicators include factors related to social well-being (employment, work lost due to injury, household income, and food security), social acceptability (public opinion, transparency, effective stakeholder participation, and risk of catastrophe), and energy security and external trade (energy security premium, fuel supply volatility, terms of trade, trade volume). Comments from workshop participants and other reviewers contributed to the publication of a paper identifying practical measures of socioeconomic aspects of bioenergy sustainability.[3]

The workshop attendees identified knowledge gaps and implementation challenges, as well as research and development recommendations, for the suite of proposed social sustainability indicators. This workshop summary includes the full range of recommendations discussed. Responding to the recommendations will require input and collaboration across multiple disciplines and institutions. Key gaps and implementation challenges identified by participants relate to:

- Lack of reliable data at appropriate temporal and spatial scales
- Insufficient understandings of multiple stakeholder perspectives
- Assessment of tradeoffs between adoption, acceptance, and overall sustainability
- Attribution
- Need to quantify uncertainty and risk
- Comparability of bioenergy to fossil fuels using common indicators.

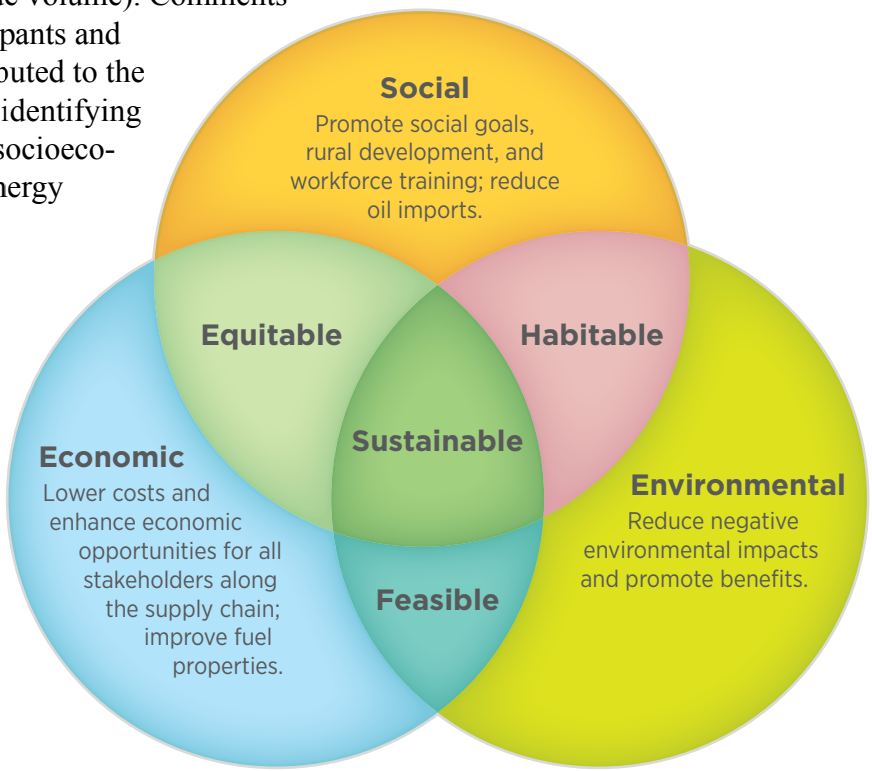


Figure 1: The social, economic, and environmental sustainability aspects of biofuel production

Introduction/Workshop Background

Using biomass resources for fuels, products, and power is widely recognized as a critical component in the nation's strategic plan to reduce greenhouse gas emissions and address our continued dependence on imported oil. Dependence on imported oil exposes the country to critical disruptions in fuel supply, creates economic and social uncertainties for businesses and individuals, and impacts national security. The Renewable Fuel Standard (RFS2) outlined in the Energy Independence and Security Act of 2007 (EISA) calls for an aggressive increase in the use of domestic renewable fuels to 36 billion gallons per year by 2022.

As policy developments encourage bioenergy production, it is critical to ensure that the industry develops in a sustainable manner. Several groups, including the Council on Sustainable Biomass Production, the Roundtable on Sustainable Biofuels, the International Organization for Standardization, and the Global Bioenergy Partnership, are in the process of developing or implementing frameworks for sustainability that could be utilized in the evaluation of bioenergy production activities across the full supply chain. These frameworks address environmental, social, and economic aspects of bioenergy production.

The Bioenergy Technologies Office's Sustainability Program

An overarching strategic goal within the Department of Energy's (DOE) Bioenergy Technologies Office (the Office) is to develop sustainable, commercially viable biomass technologies to enable the production of bioenergy nationwide and to reduce America's dependence on foreign oil through the creation of a domestic bioenergy industry. The Office recognizes the need for a viable bioenergy industry in the United States—one with the ability to foster local economic growth while improving the nation's balance of trade. To measure progress toward these goals, the Office monitors costs, profitability, productivity, and efficiency across the entire supply chain and for multiple feedstocks and pathways for conversion to energy. These economic benefits are considered together with the environmental and social impacts of bioenergy.

Sustainability is an integral part of the Office's vision. The Office's Sustainability Program works to understand and promote the positive economic, social, and environmental effects of bioenergy, while reducing potential negative impacts of bioenergy production activities. Sustainability activities are crosscutting—impacting all elements of the biomass-to-bioenergy supply chain and each stage of the development of bioenergy.

Workshop Motivation

Increasing focus on the social aspects of bioenergy arose as a result of the Office's peer review process. In 2011, reviewers suggested engaging social scientists to address two key research area needs: (1) barriers that landowners will face for growing the biomass, as well as what incentives will influence the landowners, and (2) research and development (R&D) of metrics for social impacts of land-use change, such as impacts on labor and population displacement.[4] Other commentators recommended developing specific goals for addressing social sustainability. To address these suggestions and to better anticipate and understand the impacts of the emerging bioenergy industry, the Office convened the Social Aspects of Bioenergy Workshop on April 24, 2012.

Social Sustainability Indicators

Social aspects of bioenergy sustainability relate to people themselves—their access to food and reliable energy, their standard of living in both economics and safety, and their attitudes toward bioenergy in the present and future markets. To develop a greater understanding of this range of interactions, the Office supported Oak Ridge National Laboratory (ORNL) to investigate the social sustainability aspects of bioenergy systems.

In their study, ORNL describes the social components of sustainable bioenergy to include preserving jobs and access to healthy food and ensuring continuous energy supply that supports and protects the local society and economy. Utilizing open and transparent processes that actively engage stakeholders, establish obligations for the protection of human rights, and realize a sustainability plan, which includes active monitoring of progress, are also considered critical to social sustainability activities.[5]

In order to effectively quantify and evaluate the socioeconomic attributes of bioenergy options, ORNL identified 16 indicators, which fall into the following 6 areas:

Table 1: Indicators from V. Dale, et al

CATEGORY	INDICATOR	UNITS
Social Well- Being	Employment	Number of full time equivalent (FTE) jobs
	Household income	Dollars per day
	Work days lost due to injury	Average number of work days lost per worker per year
	Food security	Percent change in food price volatility
Social Acceptability	Public opinion	Percent favorable opinion
	Transparency	Percent of indicators for which timely and relevant performance data are reported
	Effective stakeholder participation	Percent of documented responses to stakeholder concerns and suggestions reported on an annual basis
	Risk of catastrophe	Annual probability of catastrophic event
Energy Security	Energy security premium	Dollars per gallon biofuel
	Fuel supply volatility	Standard deviation of monthly percentage price changes over one year
External Trade	Terms of trade	Ratio (price of exports/price of imports)
	Trade volume	Dollars (net exports or balance of payments)
Profitability	*Return on investment (ROI)*	*Percent (net investment/ initial investment)*
	Net present value (NPV)	*Dollars (present value of benefits minus present value of costs)*
Resource conservation	*Depletion of non-renewable energy Resources*	*Amount of petroleum extracted per year (MT)*
	Fossil Energy Return on Investment (fossil EROI)	*Ratio of amount of fossil energy inputs to amount of useful energy output (MJ) (adjusted for energy quality)*

Note: Gray italic text signifies the two categories that did not fall under the scope of the Workshop.

- Social acceptability
- Social well-being
- Energy security
- External trade
- Profitability
- Resource conservation.

This collection of indicators was chosen based on available information about current social and economic conditions, as well as how closely they met the requirements of a set of established criteria, which included being practical, sensitive to stresses, unambiguous, anticipatory, predictive, measurable, and sufficient, when considered collectively.[6] These indicators are listed in Table 1.

The selected indicators provide a basis to evaluate changing conditions over time in order to advise against potentially negative outcomes related to the socioeconomic aspects of bioenergy systems. In selecting appropriate and useful indicators, researchers at ORNL had several goals in mind, including providing effective support for policy makers and planners, selecting those indicators that are applicable across the entire biofuels production supply chain, and creating a complete yet succinct set of indicators.[7]

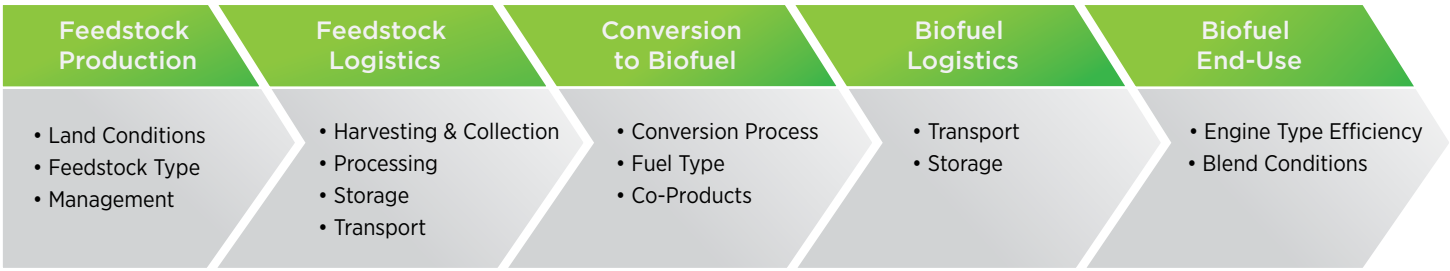
Additional research is needed to improve the relatively new and limited body of knowledge on the social aspects of bioenergy. Studies will need to adapt based on the complexity of sustainability issues, evolving definitions and conventions for measurement and

comparison, and the availability of data to quantify the selected indicators.

Workshop Purpose and Approach

The main objectives of the Social Aspects of Bioenergy Workshop were to identify knowledge gaps and implementation challenges for the set of social sustainability indicators proposed by ORNL and to develop a set of R&D recommendations. For example, in the case of the "Employment" indicator in the "Social Well-Being" category (Table 1, Row 1), participants identified challenges in obtaining information on full-time employees (FTEs) related to bioenergy and what activities could help obtain this relevant data. Discussion was also focused on whether the set of indicators was adequate to evaluate the social impacts of bioenergy. In addition, participants were asked to help define the R&D needs for specific indicators to improve knowledge and to allow for practical applications to R&D projects. All recommendations were to focus on both the biofuel supply chain as a whole and on specific steps in the supply chain. The supply chain was broken down into five individual steps, as shown in Figure 2.

Figure 2: Biofuel Supply Chain



Workshop attendees included representatives from academia, government, and national laboratories. Attendees were assigned to breakout sessions focused on one of three categories of indicators:

- Social Acceptability
- Social Well-Being
- Energy Security and External Trade.

Workshop Presentations

Four presentations were given at the workshop to frame the discussion on social sustainability. The summaries are as follows:

Barbara J Bramble: The Roundtable on Sustainable Biofuels Tackles Social Standards

The Roundtable on Sustainable Biofuels[8] (RSB) is an international "multi-stakeholder" initiative concerned with ensuring the sustainability of biofuels production and processing. Based on consultations with industry and civil society members from around the world, the RSB has developed a third-party certification system for biofuels sustainability standards encompassing environmental, social, and economic principles and criteria (Table 2). The RSB addresses a diverse array of social issues that include the concerns of developing nations, such as large feedstock plantations that might ignore undocumented land and water rights, unsafe labor conditions, unfair out-grower contracts, gender discrimination, effects on poverty/rural development in impoverished developing countries, and food security.[9] These are not common issues in the United States, but it is important to recognize that non-domestic feedstock imports may play a larger role in the future of biofuel production in the nation.

Utpal Vasavada: Expanded Demand for Biomass Feedstocks: Implications for Agriculture

Expanded demand for biomass feedstocks has implications for farm income; land, water, and chemical use; employment; commodity markets; and food security and prices. The impact will depend on how agricultural production is affected by expanded feedstock production. The use of agricultural resources depends on the decisions made by the operators of the nation's 2.2 million farms, which are shaped, in turn, by market conditions, public policies, and the specific characteristics of individual farms and households. When making these decisions, farm operators have clear incentives to consider their own and their households' well-being, but incentives to consider more distant impacts are weaker. This presentation reviewed

Table 2: The 12 Principles Behind the Roundtable on Sustainable Biofuels' Certification System

PRINCIPLE 1:	PRINCIPLE 2:	PRINCIPLE 3:
Legality	Planning, Monitoring & Continuous Improvement	Greenhouse Gas Emmisions
PRINCIPLE 4:	**PRINCIPLE 5:**	**PRINCIPLE 6:**
Human & Labor Rights	Rural & Social Development	Local Food Security

PRINCIPLE 7:	PRINCIPLE 8:	PRINCIPLE 9:	PRINCIPLE 10:
Conservation	Soil	Water	Air

PRINCIPLE 11:	PRINCIPLE 12:
Use of Technology, Inputs, & Management of Waste	Land Rights

information on farm income, land use, commodity markets, input use, food price inflation, and food security, in light of the changing demand for biomass feedstocks.

Elise Golan: Economics of Food Labeling

Product labeling is employed by private organizations, governments, and international organizations to disseminate product information to consumers. To learn more about how labeling might play a role in the bioenergy industry, Dr. Golan gave an overview of the factors considered for labeling in the food industry. For example, the ingredients for a jar of spaghetti sauce, a box of cereal, or a cup of coffee could come from around the corner or around the world. They could be grown with numerous pesticides or just a few; they could be grown on huge corporate organic farms or on small family-run conventional farms. They could be harvested by children or by machines; they could be stored in hygienic or pest-infested storage facilities; or they could increase or decrease the risk of cancer. Consumers use their purchasing power (their consumption choices) and political activities to help determine which attributes are described on labels. Private firms seek out attributes that are attractive to consumers and voluntarily provide information about these attributes when the benefits of doing so outweigh the costs. Third-party entities contribute to enhancing the intelligibility and credibility of information about food attributes through standard setting, certification, and enforcement. Policymakers are faced with weighing the costs and benefits of food labeling, as well as the distribution of benefits and costs to determine whether labeling is a cost-effective policy option. Although the biofuels industry is fundamentally different from

Table 3: Global Bioenergy Partnership's 24 Indicators of Sustainable Bioenergy Production and Use

ENVIRONMENTAL	SOCIAL	ECONOMIC
1. Life-cycle GHG emissions	9. Allocation of land	17. Productivity
2. Soil quality	10. Price and supply of a national food basket	18. Net energy balance
3. Harvest levels of wood resources	11. Change in income	19. Gross value added
4. Non-GHG air emissions	12. Jobs in the bioenergy sector	20. Change in consumption of fossil fuels and traditional biomass
5. Water use and efficiency	13. Unpaid time spent by women and children collecting biomass	21. Training and re-qualification of the workforce
6. Water quality	14. Access to modern energy services	22. Energy diversity
7. Biological diversity	15. Mortality and disease due to indoor smoke	23. Infrastructure and logistics for distribution of bioenergy
8. Land use and land-use change	16. Occupational injury	24. Capacity and flexibility of use of bioenergy

the food industry (e.g., the consumer is often unable to select substitute products at the pump), information on labeling is important to consider as the bioenergy field develops.[10]

Gerard Ostheimer: Social Indicators of Sustainable Bioenergy Production and Use

The Global Bioenergy Partnership (GBEP) promotes the continued development and commercialization of biomass used for energy, particularly in developing countries where the use of biomass is prevalent. In 2012, GBEP released a report on 24 indicators of sustainable bioenergy production and use (Table 3). These indicators were split into three categories: social, environmental, and economic. The GBEP sustainability indicators are not legally binding, do not feature directions, thresholds, or limits, and do not constitute a standard. Rather, the indicators will show progress toward or away from a sustainable development path as determined nationally.

Workshop Outcomes

Workshop results from each breakout session are discussed below. General outcomes and common themes that were concluded from the breakout sessions are noted in the Cross-Cutting section. Originally, the Workshop was intended to focus on recommendations to the Bioenergy Technologies Office; however, discussion included a range of activities that will likely require input and collaboration across multiple disciplines and institutions. This report summarizes the full range of recommendations raised during the Workshop.

Social Acceptability

The indicators of interest in the area of social acceptability are public opinion, transparency, risk of catastrophe, and effective stakeholder opinion. Workshop participants focused on public opinion and risk of catastrophe, with limited discussion on transparency and effective stakeholder participation topics.

Knowledge gaps and implementation challenges related to public opinion take account of insufficient understandings of personal perspectives, the evolving nature of public opinions, and the diversity of educational backgrounds. Participants brought up the difficulties in differentiating between local and national opinions and addressing these conflicting perceptions.

Social Acceptability Indicators

- Public opinion
- Transparency
- Effective stakeholder participation
- Risk of catastrophe

Local opinions can include those of rural communities and farmers or other civilians in the biofuels industry workforce, as well as private citizens. National opinions can include perspectives on the environment, national security, or the U.S. fuel economy. Differing spatial scales of analysis will lead to variance in the identification of stakeholders, methods to select and sample representative groups, survey instrument design, and interpretation of results. It was also mentioned that there are gaps in data linkages between indicators and other factors. For example, research is needed to determine the relationship between public opinion and community-level benefits, the general public understanding of bioenergy, and overall green/sustainability mindsets, as well as the impact of bioenergy educational programs on these opinions. Other knowledge gaps relate to the influence of aesthetics, tree harvesting, media coverage, marketing trends, and attitudinal shifts between perceptions and acceptability. Research on how directed education programs could influence public opinion could provide insight on the perceptions, opinions, attitude, and existing knowledge of bioenergy systems in the general public.

Workshop participants suggested that more data should be gathered to fill in these knowledge gaps in public opinion. Research should also be conducted on the methodologies used to dissect public opinion on individual issues, as opposed to just overall attitudes toward bioenergy. This research should account for subtleties in how the questions are asked in public opinion surveys. Workshop participants were concerned polling questions related to specific aspects of the supply chain may be too technical for broad stakeholder input or public opinion, and the public might participate in a research survey without understanding their stakes and/or benefits. Workshop participants recommended that public-opinion polling should be carried out by an independent survey group with consistent questions over time to indicate how

opinions change and evolve, but acknowledged that this method of data collection is expensive and time consuming.

Besides surveys, it was recommended that other methods of data collection should be considered, such as tracking media in relation to public opinion. Some previous studies have designated overall perceptions towards given types of renewable energy; comparative evaluations of stakeholder opinions could shed light on the relationship between stakeholder characteristics and predominant opinions within that stakeholder category (e.g., farmers' preferences for grass- vs. willow-based bioenergy, or private landholders' preferences for wind vs. biomass energy, etc.).

Workshop participants were very interested in the "Risk of Catastrophe" indicator, as well as the criteria for what constitutes a catastrophe. Dale et al. define a catastrophe as "an event or accident that has more than 10 human fatalities, affects an area greater than 1000 hectares, or leads to extinction or extirpation of a species." Examples of potential catastrophes could include biorefinery explosions or large chemical or biological spills.[11] It would be useful to gather experts on catastrophic risk to refine the indicator and further determine its usefulness before more study is done. The accuracy and interpretation of surveys on catastrophes presented a concern because even a hint of catastrophe can lead to very low levels of acceptability. The timing of the catastrophe and the analysis of public opinion might also be more relevant than the actual risk of the catastrophe, as perceived risk can change dramatically if the catastrophe happens. It is also challenging to determine the risk level of a new technology until at least the first catastrophe occurs, as there may not be enough bioenergy-related data, near-catastrophes may not be openly reported, and the data may be difficult to compare with fossil energy. More research may be needed on the opportunities for bioenergy systems to reduce or mitigate risk of catastrophe (e.g., wildfire risk mitigation and forest restoration). It was proposed that models of risk, perceived risk, and relationship to historical risk may need to be developed.

Issues such as changing or ill-defined measurements, qualitative measurements, spatial comparisons (e.g., rural vs. urban), stakeholder comparisons (e.g., producer vs. consumer), and comparisons to other technologies—especially for electricity and oil—were all identified as gaps and major challenges in evaluating social acceptability. Another large hurdle emphasized was data collection. The Workshop participants emphasized that social acceptability indicators are dynamic and need to be measured frequently. Participants commented that it may be challenging to obtain data from the private sector without proper incentives. For example, some data may be considered proprietary or landowners growing genetically modified crops may prefer to remain anonymous. In addition, baseline data from the biofuel industry is incomplete due to limited historical information. A public participation process to collect data from bioenergy companies, normalized measurements to account for growth in bioenergy, and comparative data from other energy sources could help mitigate some of these challenges.

The Workshop participants recommended multiple efforts that would address the overall challenges in social acceptability, including the following:

- Determine how to focus on specific selected indicators, both individually and collectively, yet keep a broader suite on the table.
- Determine which stakeholders the Office's investments are serving and how the indicators best apply to them.
- Identify the stakeholders that influence public decision making, and determine the processes by which stakeholder involvement builds social acceptability.
- Study the relationships and tradeoffs between adoption, acceptance, and overall sustainability, and compare bioenergy to fossil fuels for these indicators.
- Determine which data need to be obtained across the supply chain, add data to the Bioenergy Knowledge Discovery Framework (KDF), and ask stakeholders to use and comment on data.
- Create a directed education program for increasing knowledge, awareness, and affecting public norms/attitudes.
- Monitor progress and develop processes for determining baselines and targets before setting them and then quantify sustainability tradeoffs when targets are selected.

Social Well-Being

Indicators of interest under the category of social well-being were employment, household income, work days lost due to injury, and food security. Workshop participants found that topics surrounding human health hold multiple knowledge gaps due to the infancy of the biofuels industry and the sparse available data on its impacts on employees, the general public, and ecosystems (such as air and water quality). It was suggested that new surveys should be conducted, and/or existing surveys should be expanded, to obtain data that can calibrate and improve human health modeling efforts within the biofuel industry. The Office addresses aspects of bioenergy that affect health indicators under a separate set of environmental indicators including effects on air, soil, and water.[12]

Workshop participants found that issues related to employment and communities include measuring both direct and secondary effects, as commonly defined in the literature. When measuring new biofuel-related jobs, it is important to understand both new jobs created in supporting sectors, as well as job loss due to the displacement of existing industry jobs that compete with biofuels.

As for household income, there are many interacting factors that make attribution complicated. Household income research is needed to properly document the reference case (business as usual) against which bioenergy options can be compared. This situation occurs because different bioenergy options will affect household income data in different ways. In addition to impacts on household income, some alternatives may increase annual household's energy costs, while others may reduce such costs.

Indirect impact studies would also be valuable for measuring food security concerns. Food security may require an assembly of indicators, and even then, it may be difficult to parse the effects of bioenergy from many other variables. This is in part because energy is a large factor in food price, and bioenergy may influence energy prices in one direction while pressuring food commodity price in another. Participants noted that the scale or area needs to be identified for determining the influences of food and energy prices and their causal relationships to biofuels. It is important to collect data on the effects of biofuel conversion facility siting and infrastructure on communities and community services and ensure that indicators will permit comparison with other energy options.

Social Well-Being Indicators

- Employment
- Household income
- Work days lost due to injury
- Food security

General knowledge gaps that Workshop participants identified included attribution, scaling issues, and uncertainty. Attributing and measuring social well-being indicators, in relation to bioenergy, is complex. Factors such as dynamics, spatiality, direct versus indirect impacts, distribution/equity, relevance, and disaggregation issues need to be tracked. It will also be important to assess multiplier and tradeoff impacts of biofuels.

Participants agreed that an implementation challenge in social well-being indicators is the lack of data, as well as the difficulty locating, accessing, and applying data appropriately. It will be important to have geographical and project-specific data to characterize the baseline for a given indicator. Therefore, it will be a challenge to pick a scale or scope given that local and national communities affect each other. Research to measure social indicators will need clearly defined project boundaries. In addition, some data might be restricted or unavailable at the desired scale, or at specific supply-chain levels, further restricting research. The social aspects of project data may be beyond the scope of the project itself and would require outside institutions. Additionally, data gathering is costly, and public agencies may lack mandates for its collection.

Workshop participants recommended multiple efforts that would address the overall challenges in social well-being, but emphasized that different scales lead to a great deal of unknowns. It is important to promote transparent methodologies for gathering and comparing data, including the following:

- Support a project that links diverse parties currently doing case studies on social effects of bioenergy and prepare periodic "white papers"

on lessons learned and best practices. Build on what has already been done; many case studies already exist. Host forums and develop best practices and tool kits for meta-analysis methods.

- Support research to document and understand relevant causal relationships. Such projects need to clearly specify and justify the baseline trends to allow for attribution to bioenergy versus other factors (e.g., to understand variability and dynamic nature of historic trend data).
- Assess how DOE's technology and feedstock choices relate to social sustainability impacts.
- Support reference data sets for bioenergy; assemble baseline data sets for each indicator at a scale appropriate for the technology pathway.
- Support field testing of proposed indicators as components of ongoing projects and future funding (for instance, organizations funding bioenergy research can add contractual language to apply or test indicators).

Energy Security and External Trade

Indicators of interest under the categories of energy security and external trade were the energy security premium (defined as the estimate of the energy security benefits of substituting biofuels for petroleum in vehicle fuels; combines the costs of supply disruptions and price shocks with the costs of reliance on high-cost non-competitive oil supply.[13]), fuel supply volatility, terms of trade, and trade volume. Participants of this breakout session agreed that in the energy security and external trade sectors, knowledge gaps and implementation challenges stem from a lack of available data and a lack of understanding across the stakeholder community.

Workshop participants agreed there is a lack of measured data available regarding the food/fiber versus fuel choice and the socio-economic impacts of allocating crops for biofuels. It is difficult to determine how to monetize the value in producing feedstocks that have multiple potential uses, and there is a lack of data on the impact of changing farming systems (corn stover use to energy crops) on the net-value of particular feedstock crops. The participants suggested conducting research on why and how farmers switch the crops that they grow. They also agreed that research should be conducted on multi-use biomass

Energy Security and External Trade Indicators

- Energy security premium
- Fuel supply volatility
- Terms of trade
- Trade volume

options that can be used for fuel, biopower, food, and fiber. It would be beneficial, specifically regarding the fuel supply volatility indicator, for the Office to assess the social (non-economic) factors that might influence landowners' willingness to change crops.

When asked to identify knowledge gaps pertaining to energy security and supply, participants noted that current methods used to estimate the sensitivity to disruptions, either intentional or accidental, are inadequate or in a developmental state. National security issues associated with the lack of a domestic fuel supply also need to be measured and better understood. In order to better evaluate energy security, the ability to accurately quantify the risk factors and preferences that determine the security premium on alternative fuels first needs to be improved. Lifetime estimates of risk and security can require forecasts of shock events and market performance that are outside past experience and observed data. Furthermore, it is difficult to disaggregate the impacts of biofuels on price volatility from other external factors. More information is needed on what determines an 'acceptable' or an 'allowable' amount of price volatility. It was recommended that bioenergy supply logistics networks should be designed for robustness/resilience to disruption. Additionally, participants stated that the impacts of bioenergy on fuel price volatility and agricultural volatility need to be measured, as it is difficult to estimate the impact of biofuel production on gasoline and diesel prices. An economic evaluation of alternative biofuel blending logistics (e.g., blender pumps versus "drop-in" fuels) should be conducted to help guide R&D investment. In conjunction with fuel-blending studies, there should be studies on the scope and cost of biorefinery flexibility (inputs and outputs). Research should be conducted to determine what model(s) should be used to estimate the economic consequence of biofuels and to study the impact

of alternative biofuel pathways (feedstock logistics, biorefining technology, etc.) on fuel supply and price volatility.

Workshop participants focused on the knowledge gaps and challenges pertaining to trade units and trade tariffs. There was consensus that biofuel types must be distinguished from one another for trade measurements. Processes must also be established to account for the trade of multiple co-products to get an aggregate measure of trade effects. The impact of eliminating import tariffs on biofuels and energy security also requires further research. Participants concluded that further R&D in these categories could improve current modeling of the impacts of climate change, heterogeneous bioenergy policy, and feedstock productivity on global trade patterns over the next century.

Workshop participants stressed the possible difficulties in gaining consensus about appropriate baselines for energy security and external trade indicators. Participants also noted that a baseline trend for oil prices would need to be established, along with a reference scenario. In addition, having historic reference points for fuel and agriculture supplies, prices, shocks, and trades would be useful; however, setting static targets can reduce incentives for improving beyond the set target, making the process for developing targets for continual improvement difficult.

Workshop participants recommend the following cross-cutting strategies with regard to energy security and external trade:

- Use scenario or storyline-based approaches to simulate market outcomes.
- Support research to determine the target value for the indices associated with fuel supply volatility. Research should use a scenario or storyline-based approach to stimulate future fuel market outcomes under alternative drivers.

Cross-Cutting

In each of the breakout sessions, Workshop participants were asked to consider baselines and targets for their specific indicators. Many groups had the opinion that baselines and targets are a matter of perspective and that determining baselines and setting targets for social indicators is inherently political and requires a democratic process, even when technical information is involved. For some indicators (e.g., social acceptability), historical baselines may not be pertinent. There was also concern that moving targets are expensive to the industry and could limit industry's participation in aiming to achieve those targets. While at times determining baselines and setting targets can help drive technological development, Workshop participants stressed that they can also sometimes lead to unintended consequences.

Data acquisition was another area of general concern. In terms of the supply chain, participants agreed that for most new feedstocks, there are no reliable data for tracking costs of production, logistics, and conversion. This is also the case with most start-up biofuel production facilities, as they will have a reluctance to share data on their products and processes due to proprietary concerns. This will limit the amount of current data available.

Workshop participants also recommended some wide-ranging R&D suggestions. All groups emphasized the necessity of data transparency. Including social and behavioral scientists in the range of expertise of all projects was also proposed to make conceptual thresholds as relevant in social acceptability as they are in environmental science. Because many of the indicators relate to environmental science, it was recommended that the Office should help standardize life-cycle analysis protocols and study the long-term impacts of climate change on the entire biomass life cycle. This would include research that tests indicators of interest in multiple contexts and scales—forestry and agriculture, biofuels and bioenergy, etc. Participants suggested that when conducting this research, and all other life-cycle and cross-cutting R&D, it will be important to deploy context-specific case studies using different locations, feedstocks, scales, and conversion processes. It was advised that the candidate indicators should be applied and tested cooperatively in another "biofuels" country (e.g., Brazil) to aid in the overall process. Participants were concerned with the idea of creating a "grand model" of sustainability, because these models are too dependent on value assumptions and never truly represent the infinite linkages between production, consumption, and sustainability.

Summary/Concluding Comments

A follow-up webinar was held for the public on May 8, 2012, to support the goals and conclusions of the Workshop. The webinar explained the objectives of the Workshop and included detailed presentations from each of the three breakout sessions summarizing the main outcomes from their discussions. At the end of the presentations, webinar participants were given an opportunity to provide feedback on additional knowledge gaps, implementation challenges, and R&D recommendations.

The Bioenergy Technologies Office currently has several projects working to understand and address social aspects of bioenergy sustainability. For example, the Jobs and Economic Development Impacts (JEDI) model, developed at the National Renewable Energy Laboratory, is being refined and used to estimate the jobs impacts of a growing domestic bioenergy industry. ORNL is developing capabilities to assess the benefits, costs, and indirect impacts of domestic biofuel policies at a global scale. Additional work at ORNL is analyzing the effect of biofuels on gasoline prices and price volatility.

As a result of the Workshop, the Office is taking a closer look at its existing projects to identify data streams and analyses already underway that address the data gaps and research needs identified. The Office will use this summary report to inform discussions on new activities and to solicit additional input from stakeholders.

End Notes

[1] Formerly the Office of the Biomass Program

[2] US DOE Biomass Program, Sustainability Platform Review Report, February, 2012. http://www1.eere.energy.gov/biomass/pdfs/2011_sustainability_review.pdf

[3] Dale VH, RA Efroymson, KL Kline, MH Langholtz, PN Leiby, GA Oladosu, MR Davis, ME Downing, and MR Hilliard, "Indicators for assessing socioeconomic sustainability of bioenergy systems: A short list of practical measures," Ecological Indicators, 2012.

[4] US DOE Biomass Program, Sustainability Platform Review Report, February, 2012. http://www1.eere.energy.gov/biomass/pdfs/2011_sustainability_review.pdf

[5] Ibid.

[6] Ibid.

[7] Ibid.

[8] Now the Roundtable on Sustainable Biomaterials (www.rsb.org)

[9] See www.rsb.org for more information on RSB Social Standards.

[10] For more information see Economics of Food Labeling by Elise Golan, Fred Kuchler, and Lorraine Mitchell with contributions from Cathy Greene and Amber Jessup. Economic Research Service, U.S. Department of Agriculture. Agricultural Economic Report No. 793. http://www.ers.usda.gov/publications/aer-agricultural-economic-report/aer793.aspx

[11] Dale VH, RA Efroymson, KL Kline, MH Langholtz, PN Leiby, GA Oladosu, MR Davis, ME Downing, and MR Hilliard, "Indicators for assessing socioeconomic sustainability of bioenergy systems: A short list of practical measures," Ecological Indicators, 2012.

[12] For example, see McBride A, et al. 2011. Indicators to support environmental sustainability of bioenergy systems. Ecological Indicators 11(5) 1277-1289.

[13] Dale VH, RA Efroymson, KL Kline, MH Langholtz, PN Leiby, GA Oladosu, MR Davis, ME Downing, and MR Hilliard, "Indicators for assessing socioeconomic sustainability of bioenergy systems: A short list of practical measures," Ecological Indicators, 2012.

Appendix A – Workshop Agenda

Social Aspects of Bioenergy Sustainability Workshop, April 24, 2012

8:30 - Welcome and introductions

8:45 - Overview of the DOE Bioenergy Technologies Office vision, R&D activities, current sustainability efforts and approaches, need for R&D on social aspects of sustainability, and goals for the workshop

- Kristen Johnson and Ranyee Chiang, DOE Bioenergy Technologies Office

9:15 - Overview of international and other federal efforts on the social aspects of sustainability

- The Social Pillar of Sustainability Indicators from the Global Bioenergy Partnership (GBEP) - Gerry Ostheimer, U.S. Department of Agriculture (USDA)
- Social Indicators of Sustainability at the Roundtable on Sustainable Biofuels (RSB) – Barbara Bramble, RSB Board and the National Wildlife Federation
- Sustainability Efforts at the USDA - Elise Golan, USDA Office of the Chief Economist (OCE)
- Socioeconomic Research at the USDA Economic Research Service (ERS) - Utpal Vasavada, USDA ERS

10:15 - Indicators to support assessment of socioeconomic sustainability of bioenergy systems

- Virginia Dale, Center for Bioenergy Sustainability, Oak Ridge National Laboratory

10:45 – Divide into breakout groups based on the following indicators from ORNL's work:

- Indicators of social well-being (Employment; Household income; Work lost due to injury; Food security)
- Indicators of social acceptability (Public opinion; Transparency; Effective stakeholder participation; Risk of catastrophe)
- Indicators of energy security and external trade (Energy security premium; Fuel supply volatility; Terms of trade; Trade volume)

10:50 - BREAK

11:00 - Breakout Part 1: Knowledge gaps of indicators

- What are the gaps in methods of measurement and data?
- What are the gaps in understanding the relationships between the indicator unit and potentially related conditions?
- Based on these specific gaps, what are the overall gaps in knowledge for the indicators?
- What Bioenergy Technologies Office R&D efforts do you recommend to fill the key knowledge gaps of the indicators?

12:30 - LUNCH

1:30 - Breakout Part 2: Implementation challenges of indicators

- What are the challenges for bioenergy industry stakeholders to collect and track data for these indicators?
- What are the challenges in determining a baseline for each indicator?
- What are the challenges in selecting a target for each indicator?
- Based on these specific challenges, what are the overall implementation challenges for the indicators?
- What R&D efforts do you recommend to address the implementation challenges for the indicators?

2:45 - Revise draft R&D recommendations and prepare summary presentations for the large group

3:15 - Breakout session report-outs to the large group

4:00 - Q&A and large group revisions of recommendations

5:00 - Finalize R&D recommendations to the Bioenergy Technologies Office

5:30 - Adjourn

Appendix B – Workshop Attendees

NAME	AFFILIATION
Energy Security and External Trade	
Dennis Becker	University of Minnesota
Jeffrey Bielicki	University of Minnesota
Erik Dohlman	USDA, Economic Research Service
Rachael Jonassen	LMI
Paul Leiby	Oak Ridge National Laboratory
Siwa Msangi	International Food Policy Research Institute
Gerard Ostheimer	U.S. Department of Agriculture
Mark Palmer	Van Ness Feldman, P.C.
Renee Schwartz	USDA, Foreign Agriculture Service
Paul Trupo	USDA, Foreign Agriculture Service
Social Acceptability	
Daniel Cassidy	USDA Office of Chief Scientist
John Cowie	Agenda 2020 Technology Alliance
Virginia Dale	Oak Ridge National Laboratory
Rebecca Efroymson	Oak Ridge National Laboratory
Chris Farley	USDA Forest Service
Elise Golan	U.S. Department of Agriculture
Erin MacDonald	Iowa State University
Nirav Patel	Cornell University
Theresa Selfa	SUNY ESF, Dept. of Environmental Studies
Social Well-Being	
Peter Arbuckle	USDA, National Institute of Food & Agriculture
Jill Auburn	U.S. Department of Agriculture
Barbara Bramble	National Wildlife Federation
Jody Endres	University of Ilinois
Stephen Gasteyer	Michigan State University
Ralph Gifford	USDA, Foreign Agriculture Service
Keith Kline	Oak Ridge National Laboratory
Pankaj Lal	Montclair State University
Al Luloff	Pennsylvania State University
Satya Narina	Virgnia State University
Gbadebo Oladosu	Oak Ridge National Laboratory
Donna Perla	US Environmental Protection Agency
Utpal Vasavada	USDA, Economic Research Service
Other Attendees	
Ranyee Chiang	DOE, Bioenergy Technologies Office
Aaron Crowell	BCS, Incorporated
Alison Goss Eng	DOE, Bioenergy Technologies Office
Kristen Johnson	DOE, Bioenergy Technologies Office
Alicia Lindauer	DOE, Bioenergy Technologies Office
Sarah Luchner	BCS, Incorporated
Ashley Rose	BCS, Incorporated

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