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TESTIMONY BEFORE THE SUBCOMMITTEE ON ENERGY AND ENVIRONMENT, COMMITTEE ON SCIENCE AND TECHNOLOGY

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Chairman Lampson and Congressman Inglis, thank you for the opportunity to appear today before the House Science and Technology Subcommittee on Energy and Environment to discuss research and development opportunities and priorities related to the environmental impacts of biofuels expansion. My name is David Waskow, and I am the International Program Director at Friends of the Earth. Friends of the Earth is a national advocacy organization in the United States founded in 1969 and the U.S. arm of Friends of the Earth International, the world's largest environmental federation, with groups in more than 70 countries worldwide.

In the United States and abroad, biofuels are often viewed as an essential solution to the linked challenges of global warming and our dependence on oil. If done right and at the appropriate scale, biofuels can indeed make an important contribution to reducing greenhouse gas emissions, improving agricultural sustainability and protection of natural resources, and strengthening rural economies. However, these results are by no means guaranteed, and we must be vigilant in ensuring that the potential of biofuels is in fact achieved. Without serious consideration of environmental impacts, increased biomass production could harm water, air and soil quality, decrease water availability, and increase loss of biodiversity, wildlife habitat, and sensitive ecosystems, while providing only minimal benefits or even negative outcomes in terms of greenhouse gas reductions.

Recent data regarding increases in the scale of biofuels production, as well as current policy proposals aimed at significantly increasing the levels of biofuels production, make the consideration of environmental benefits even more of a pressing concern. According to Department of Energy data, U.S. ethanol production increased from 3.4 billion gallons in 2004 to an annual rate of 6 billion gallons at the beginning of 2007, and annual biodiesel production expanded from 28 million gallons to approximately 287 million gallons from 2004 to 2006. Meanwhile, annual imports of biofuels have also steadily increased. More than 10 percent of fuel-grade ethanol came from abroad in 2006, despite the current 54-cent per gallon tariff on ethanol, and there has been an upswing in the construction of plants, such as a 100-million gallon per year facility in Washington State, designed to import palm oil for biodiesel. Legislative proposals to dramatically increase the use of biofuels in the United States to more than 30 billion gallons annually would accelerate these already existing trends both for domestic production and imports.

As biofuel production and use rapidly increases, a robust research and development program is urgently needed to ensure that we understand the full scope of the environmental implications of biofuel production and that investment in promising technologies results in significant greenhouse gas reductions and the best environmental outcomes possible. Greenhouse gas emissions and environmental impacts vary enormously by feedstock and the full life-cycle of the production process. Moreover, the increased scale of biofuels production itself raises important questions of environmental sustainability, especially in terms of land use impacts. Research and development efforts should consider these impacts thoroughly and help steer future biofuels production in a way that can maximize benefits and minimize environmental harm.

Life-Cycle Analysis

Perhaps the most important task for research in coming years is to more thoroughly examine the environmental impacts of biofuels production on a life-cycle basis, particularly to determine the actual greenhouse gas emissions associated with biofuel production. At their best, life-cycle analyses for greenhouse gas emissions estimate the emissions associated with the entire chain of production and end-use of a particular biofuel, including impacts associated with land use, feedstock production, fuel processing facilities, transport, and consumer end-use. The greenhouse gas evaluation of renewable fuels on a life-cycle basis can help provide the underlying technical foundation for policy options, particularly when the life-cycle emissions are compared to the life-cycle emissions from conventional fossil fuel-based fuel. Particularly given recent legislative proposals that would base renewable fuel mandates and other fuel policies on the greenhouse gas profile of specific fuels, it is imperative that life cycle analyses are comprehensive and accurate. Indeed, getting these analyses wrong could upend the entire policy framework.

The current generation of life cycle analyses, including the well-known GREET model developed at Argonne National Laboratory, examine a wide range of life-cycle contributors to greenhouse gas emissions (including not only carbon emissions, but also gases such as methane and nitrous oxide). Unfortunately, however, even the GREET model, which is considered the pace-setter for greenhouse gas modeling, is inadequate and contains important uncertainties that must be addressed. Many in the scientific community have echoed our concern that life-cycle analyses must be improved to address the full scope of greenhouse gas emissions related to biofuels production.

Land use-related impacts, in particular, are poorly characterized in current life-cycle analyses, and broader and deeper research is needed to quantify the full range of parameters affecting greenhouse gas emissions. In their recent technical analysis of California's Low Carbon Fuel Standard for the California Air Resources Board, University of California professors Alexander Farrell and Daniel Sperling noted the limitations of the GREET model in terms of land use change. The land use impacts of expanded biofuels production will include shifting marginal, unused or ecologically sensitive land into biofuels production, potentially changing the underlying assumptions about greenhouse gas emissions for biofuels produced both domestically and internationally. The scale of land use conversion for biofuels production, the types of land being converted, and the land intensity of various biofuel feedstocks will likely have significant impacts on greenhouse gas outcomes in ways that current models do not fully account for.

The recent surge in corn ethanol production in the United States underscores the importance of examining these greenhouse gas issues closely. USDA estimated that corn acreage in the United States would increase by 15 percent, or 12 million acres, during the spring 2007 planting season. Legislative proposals currently under consideration would further increase pressure on land, expanding corn ethanol production to as much as 15 billion gallons annually, an amount that would require using land equivalent to half the current corn acreage in the country, or 45 million acres.

The greenhouse gas implications of this land use will depend on the types of land that are used for such biofuels production, including whether protected lands such as those in the Conservation Reserve Program are retired from that program and placed into ethanol production. Yet even if the land put into biofuels production is currently farmed with other crops, the use of that land is likely to displace some level of existing agricultural production, including to production on vulnerable lands outside the United States. Other, indirect impacts that might occur due to the use of corn for ethanol could also be considered in a comprehensive life-cycle analysis. For example, when an acre of corn is diverted for ethanol, livestock operations around the world will replace most of the corn in some other way, which on a worldwide basis could result in the conversion of additional land to agricultural production.

The greenhouse gas emissions related to the increased use of land for corn ethanol production could be quite substantial. Based on estimates by the Argonne National Laboratory, the per-acre greenhouse gas benefits from corn ethanol production compared to conventional gasoline amount to 0.6 metric tons of carbon dioxide equivalent. By contrast, the Intergovernmental Panel on Climate Change estimates that clearing an acre of grassland would produce 45 to 80 tons of carbon dioxide equivalent greenhouse gases and converting an acre of forest will commonly release 200 to 300 metric tons of carbon dioxide equivalent greenhouse gases. The implications of these data are substantial. Even small increases in the use of land converted from grasslands or forests would undo the greenhouse gas benefits from corn ethanol production on an acre of land. While it would be reasonable to amortize the greenhouse gas impacts from land conversion over a limited number of years, doing so would not limit the quite significant immediate impacts of the land conversion.

Careful analysis of the greenhouse gas impacts of land use conversion is also relevant for biofuel feedstocks other than corn, including for production outside the United States. In Southeast Asia, for example, palm oil production is increasingly shifting from a focus on food inputs to production as a biodiesel input. Unfortunately, despite palm oil’s high energy content, the production of palm oil is a major source of destructive land use patterns, particularly due to deforestation and wetland conversion. Nearly 50 percent of currently productive palm oil plantations in Southeast Asian countries is planted on land that was recently converted from forest, releasing substantial quantities of greenhouse gases. Meanwhile, a quarter of all palm oil plantations in Indonesia are established over converted peatlands, which have been drained and often then burned to make way for palm production. Wetlands International estimates that peatland drainage and burning in Indonesia contribute 2 billion tons of carbon dioxide emissions annually, or 8 percent of worldwide carbon emissions.

Similarly, in Brazil, rapidly expanded production of biofuels is likely to increase land use pressure in ways that could influence the greenhouse gas profiles of those fuels. In the case of sugarcane production for ethanol, which already occupies 13 million acres in Brazil, expanded sugarcane production could take place on the country's significant quantity of degraded and fallow land. However, many observers believe it is likely that expanded production will also increasingly move into the Brazilian *cerrado*, the biodiverse tropical savannah. In addition, sugarcane production in Brazil frequently encroaches on previously occupied lands, which often results in crop and livestock production relocating to land converted from savannah or rainforest. Meanwhile, although soybean cultivation for biodiesel production in Brazil is still relatively undeveloped, the potential for pressure on sensitive lands is significant. Soybean production currently occupies more than 22 million acres and frequently drives widespread deforestation.

In addition to conducting more comprehensive analysis of the greenhouse gas impacts of land use changes, other elements of greenhouse gas life-cycle analyses should also be strengthened. For example, one of the most significant remaining uncertainties in life-cycle analysis is the impact of nitrous oxide emissions, an important greenhouse gas related to agricultural production. Several potential sources of nitrous oxide emissions, including the use of crop residues, are not included in any major life-cycle analysis. In addition, greenhouse gases emissions related to energy use for irrigation are not included in the GREET life-cycle analysis.

Beyond the critical task of analyzing the greenhouse gas emissions associated with renewable fuels, life-cycle analyses should also be expanded to address a full range of potential environmental impacts from biofuels production. This will be especially important in order to compare the impacts of various biofuels in terms of their relative impacts on soil quality, water use, water quality (including such critical issues as nitrogen and pesticide run-off), air quality, and protection of native ecosystems, habitats and biodiversity. As next-generation renewable fuels, such as cellulosic ethanol, become increasingly viable both technologically and commercially, it will be critically important to be able to compare the entire range of impacts of those fuels with conventional biofuels. In addition, analysis of the aggregate and cumulative environmental impacts related to the growth of the entire biofuels sector, both domestically and internationally, should be developed.

Finally, one of the most significant gaps in research on the environmental impacts of biofuels is the extremely limited set of feedstocks that have been analyzed in any detail. Broader research on environmental impacts and the development of comprehensive life-cycle analyses are needed for a number of feedstocks other than corn – including soy, sugarcane, palm oil, canola, native grasses, various wood sources, straight vegetable oil (including waste vegetable oil), and crop residues. In some instances, greenhouse gas life-cycle analyses have been conducted for those feedstocks, but broader and deeper analysis would add significantly to the understanding of the greenhouse gas and other environmental impacts from those fuel sources. In addition, most studies of biofuel production use broad averages for analyzing impacts and land-use intensity, rather than geographically-specific data. Variability across regions of the United States and the world can be significant and should be included in these analyses.

Research and Development for Best Practices and Advanced Biofuels

It is increasingly clear that our domestic demand for biofuels far exceeds our supply of corn for conversion to corn-based ethanol, currently our major source of biofuels in the United States. Meanwhile, the recent rapid expansion of corn-based ethanol production has helped stir increased concern about the environmental sustainability of biofuels production more broadly. If we hope to continue the growth of a sustainable biofuels industry in the United States, we must find ways to steer the sector in directions that will be most compatible with our fundamental environmental goals. Research and development must tackle the challenge of promoting best practices for biofuel production and facilitating the development of improved, advanced biofuels sources.

Research into best practices for the cultivation and harvesting of feedstocks will be especially critical to the environmental sustainability of biofuels production. Examples of the issues that research need to address include harvest timing and quantities; crop rotations; fertilizer requirements; use of appropriate and safe chemicals for cellulosic crops; impacts of crop residue utilization; potential integration of no-till and organic farming to provide the greatest possible greenhouse gas and soil benefits; use of single-pass harvesting; and feedstock processing and handling methods for woody biomass and perennial grasses. The research agenda for best practices should also prominently include issues involving crop diversification and appropriate mixes (including cultivation techniques for mixed perennial crops). A recent University of Minnesota study showed that diverse perennial grass mixes are more beneficial in reducing greenhouse gas emissions and other environmental impacts than is the case with other approaches, including monocropping of switchgrass.

In addition, a research and development program for conventional plant breeding of cellulosic and other feedstocks could help develop biofuels that are less land-intensive and promote environmental sustainability in other ways. Pursuing conventional breeding, rather than using an approach involving transgenic engineering, would avoid significant controversy and trade-related disputes and would avoid contamination of the food supply from genetically engineered biofuel feedstocks.

Sustainable practices for biofuel processing facilities, particularly for energy and water use, should also be a research and development priority. Research on the most effective ways to use biomass for powering biofuel processing facilities could be particularly important to creating greenhouse gas and air quality benefits. In addition, research on minimizing water use by ethanol processing plants, which currently use more than 4 gallons of water to every gallon of ethanol produced, will be critical to limiting the potentially intense pressure that biofuels production could place on water resources.

Research and development for improved fuel types is also critical. Potential alternative biofuel sources such as straight vegetable oil and algae have received too little attention and should be made more central to a research and development strategy. Straight vegetable oil (including waste vegetable oil) can be used in modified diesel engines without processing into biodiesel, thereby reducing the life-cycle greenhouse gas emissions that would otherwise come from a biodiesel production process. However, in order to make straight vegetable oil technologically and commercially viable, research and development will be needed for vehicle engine modifications. Another promising fuel source is algae, which can likely be produced in substantial quantities for biodiesel with significant greenhouse gas reduction benefits and limited environmental impacts. It would be valuable to support a research and development program to facilitate production of environmentally-sound and commercially viable algae biodiesel.

Finally, it will be vital to support a research and development agenda for small-scale production and local and on-farm use of biofuels. Distributed technologies that can be used to provide local co-generation of electricity and heat and to produce biofuels, particularly biodiesel, for on-farm use, should be priorities of this research and development program. Small-scale gasification technologies for conversion of cellulosic biomass also offer significant opportunities that should be explored. These approaches are important not only in the United States, but can also be developed for use in developing countries so that local communities in those countries can produce biofuels for their own consumption and economic benefit.