**Robert Brown, Iowa State University**

**Question 5**

Which of the new approaches to biofuels will be most successful in generating GHG emission savings? How should these be encouraged? Are there any reasons why these new approaches should NOT be encouraged?

Any approach that reduces the amount of fossil fuels used in the manufacture of biofuels should be encouraged as the most effective way to reduce GHG emissions. Eliminating aqueous phase distillations from processes would be a significant savings in this respect. Systems that capture some of the carbon in biomass as a carbon sequestration agent are highly desirable such as biochar from fast pyrolysis or co-gasification of coal and biomass combined with Carbon Capture and Sequestration (CCS).

**Question 7**

Which of the new approaches to biofuels will be most successful in supporting economic development? How should these be encouraged? Are there any reasons why these new approaches should NOT be encouraged?

We need to acknowledge that tropical countries represent the convergence of economic need, ecosystems critical to the health of the planet, and high potential for commercial biomass production. A system for producing biofuels that balances these three considerations would be a remarkable achievement. Such a system might prove to be fast pyrolysis of biomass to generate bio-oil and bio-char with the bio-oil refined to drop-in fuels and the biochar returned to the soil for the triple benefits of sequestering carbon, recycling nutrients, and building anthropogenic soils.

**Question 11**

What are currently the main constraints to R&D in new approaches to biofuels?

Until the last two or three years, the energy sector saw little prospect for biofuels and most investment came from government agencies. Most of these agencies, working with limited funding, too quickly down-selected on a few technologies (for example, enzymatic hydrolysis of cellulose in the United States), in the hope of hurrying along development. Unfortunately, this approach prevented serious consideration of other pathways to biofuels and actually slowed commercial development.

Today, companies are investing in biofuels and government funding is increasing. Both developments will encourage research on multiple pathways to biofuels. However, there may still remain pressure at the federal agency to pick winners and losers prematurely in an effort to move into demonstration projects.

**Question 12**

Where should R&D for new approaches to biofuel be targeted, and who should decide about future biofuel R&D strategies.

Some government agencies have been convinced by the scientific community that basic research will eventually lead to “breakthroughs” and “paradigm shifts” in the way we produce and use energy. Undoubtedly this will be the case, but the contributions of basic research are measured in decades, not a few years. Other government agencies have been convinced by engineering companies that the quickest

path forward is to concentrate resources into large demonstration projects, but often the technology is not sufficiently mature to even reliably design the plant. What is missing is investment in process development units or small pilot plants that integrate all the essential unit operations into a system for converting biomass into fuels and other products. Such systems would provide the data needed for designing demonstration projects and informing the basic research programs of the funding agencies.

**Question 15**

Should indirect land use change (iLUC) be considered when evaluating the GHG emissions savings of new approaches to biofuels, and if so, how?

iLUC is an ineffective mechanism for influencing deforestation or other land conversions that result in greenhouse gas emissions. There are too many factors other than the price of crops that influence decisions about land use for this to be an effective GHG policy tool. It ignores the fact that holding the biofuels industry responsible for something they cannot control (decisions by individuals and companies in the developing world) means that the policy will not produce the desired effect. Furthermore, it fails to address the fact that all unsustainable agricultural practices contribute to GHG emissions, whether for food or fuel.

Instead, we need to acknowledge that ALL economic activity affects GHG emissions: every product in the market has "embedded carbon" associated with its manufacture, which should be assessed against the manufacturer (and ultimately the final consumer) of the product. This includes fuels, food, and any other product that contributes to GHG emissions.

More effective than an iLUC policy would be an embedded carbon valuation system, which tracks GHG emissions along the value chain of a product's manufacture and distribution to consumers. Something akin to a value-added tax would be assigned to the product proportional to the amount of "embedded carbon." Thus, suppliers all along the value chain would have an incentive for reducing GHG emissions associated with their agriculture and manufacturing activities. This provides an effective mechanism for actually controlling GHG emissions.