

# Gap Analysis of Tools Used to Assess the Environmental Impacts of Biofuels in the United States

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The issue of environmental sustainability related to bio-based materials is a complicated one. Achieving sustainability requires a re-thinking of our systems of production, consumption and waste management and an increased awareness of the need to avoid the shifting of problems, which often occurs with isolated measures. The ecological advantages should outnumber, or outweigh, the disadvantages to the environment and human health. The benefits of bioenergy have come under increasing scrutiny as researchers look closer at the global environmental impact of their production. For example, diverting corn to make bioethanol could result in shifting production to competing crops, such as soybean, or the conversion of lands to use for corn production. The overall impacts of these types of shifts are not well understood. If used properly, bioenergy can help the U.S. meet its needs while maintaining ample supplies of food, animal feed, and clean water. To make this happen, well thought out national bioenergy policies that support the best options are needed for both the short and long-term future.

Life Cycle Assessment (LCA) can assist decision-makers in evaluating the comparative potential cradle-to-grave, multi-media environmental impacts of their actions in order to prevent unintended consequences. Some studies are called 'life cycle analysis' but focus on a particular issue or pollutant of concern, such as greenhouse gas (GhG) emissions, or the net energy gain or loss question. These focused studies fall short of a complete life cycle approach that helps us recognize how our choices influence each point of the life cycle so that we can balance potential tradeoffs and avoid shifting problems from one medium to another and/or from one life cycle stage to another.

This paper summarizes the results of a study that aimed to explore how the application of a systems-based approach helps decision-makers view the potential 'cradle-to-grave' impacts of biofuels and, thereby, choose the most favorable options that will keep us on the path toward sustainability. Nine tools that have been used to evaluate biofuels in the U.S. were studied and compared: Carbon Management, Ecological Footprint, Exergy Analysis, Fuel Cycle Analysis, Greenhouse Gas Life Cycle Analysis, Life Cycle Assessment, Material Flow Analysis, and Net Energy Balance. Specific examples of studies on corn ethanol production and use in the U.S. are provided, where available, to highlight the differences among the tools in the information that they generate.