Grand Challenges for reliable Life-Cycle Assessments for biofuels

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Overview: Seven Challenges

Grand Challenges for Life-Cycle Assessment of Biofuels


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INTRODUCTION

To address energy security and climate-change concerns, biofuels are emerging as an important class of substitutes, today dominated by ethanol that is produced from corn and sugar cane. For the future, many LCA follows internationally accepted approaches and practices to determine the productivity to support biofuel production. "Life cycle" refers to all steps of material extraction through manufacture to ultimate disposal, including all steps. Conducting an LCA entails: (1) choosing and defining the goal and scope of the cycle; (2) collecting and analyzing inventory data on materials and wastes; (3) conducting a life-cycle characterization, which provides anranking along with sensitivity and uncertainty analysis in decision-making. This paper emerged from recent meetings of the Life-Cycle Program Institute at the University of California and applying LCA to assess the environmental impacts of biofuel and a wide range of mitigation strategies. LCA practitioners focus on the following impact categories: climate, human health, water resources, and other external costs. LCA practitioners can provide the possible impacts and economic factors here. In selecting the impact categories.

① Understanding farmers, feedstock options, and land use
② Predicting production technologies & practices
③ Characterizing tailpipe emissions and their health consequences
④ Incorporating spatial heterogeneity: inventories and impacts
⑤ Accounting for time in impact assessments
⑥ Assessing transitions as well as end states
⑦ Confronting uncertainty and variability
(1) Understanding farmers, feedstock options and land-use

- Future feedstocks may come from farms, rangelands, or forests
- Farmers (biomass producers) reflect thousands of individual decision makers—not a single entity
- How does land use really work?

(2) Predicting production technologies & practices

- Lack of knowledge about how biomass production operations and fuel production from biomass will evolve
- Understand the energy, biomass, pollutant, and product mass balances of production facilities
(3) Characterizing tailpipe emissions and impacts

- Transportation is a major cause of urban air pollution
- Accurate emission factors for future fleets that cover a range of fuel alternatives and vehicle technologies

(4) Incorporating spatial heterogeneity

- Geographic variability is important for air pollutant health impacts, land use, water use
- Capture spatial variation at appropriate scales (from global to farm-level)
(5) Accounting for time

- Tracking fuel and transportation system changes in time and allocating impacts that accrue over time
- Time allocations are important yet rarely made clear in LCA

(6) Assessing transitions as well as end states

- Both advocates and critics of biofuels focus on a restricted set of scenarios to reinforce prior beliefs
- Even accomplished LCA practitioners tend to focus on system end-states
- We must also consider impacts that accrue during the transition phase
(7) Confronting uncertainty and variability

• Addressing uncertainty is among the greatest of the grand challenges for biofuels LCA

• Uncertainty and variability, both inherent and epistemic, arise in climate-change, human-health, environmental, and economic impact assessments
Recommendations

- Address technology momentum
- LCA in adaptive decision making
- LCA as a process not a product
Thank you

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