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Grand Challenges for reliable Life-Cycle Assessments for biofuels

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Overview: Seven Challenges

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FEATURE

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Grand Challenges for Life-Cycle Assessment of Biofuels

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INTRODUCTION

To address energy security and climate-change concerns, substitutes are needed for petroleum-based transportation fuels. In addition to electricity and natural gas, 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 acce
and ISO 14044) and practices to
impacts of technologies, processes
determine their propensity to consu
pollution. "Life cycle" refers to all st
material extraction through manufac
to ultimate disposal, including all
steps. Conducting an LCA entails f
defining the goal and scope of the
cycle inventory data on materials a
and wastes; (3) conducting a life-cy
characterizes the impacts of const
interpretation, which provides an an
along with sensitivity and uncerta
decision-making.[3]

This paper emerged from resea
meetings of the Life-Cycle Program
Institute at the University of Califor
and applying LCA to assess the env
transportation fuels, LCA practition
following impact categories: climat
emissions and impacts, water-re
changes, nutrient needs, human an
and other external costs. LCA prac
social impacts and economic factor
here. In selecting the impact catego

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

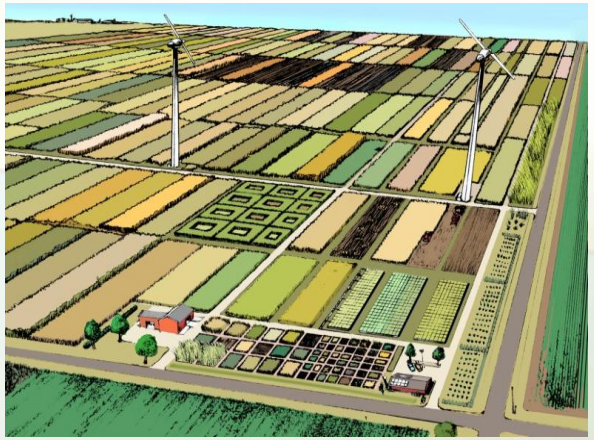
⑤ Accounting for time in impact assessments

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

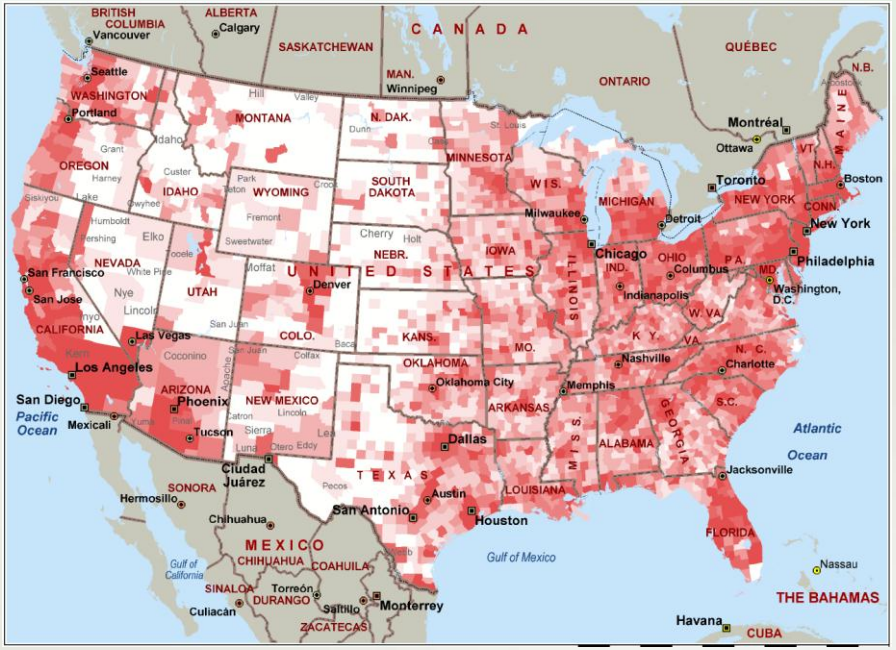
- Lack of knowledge about how biomass production operations and fuel production from biomass will evolve
- Understand the energy, biomass, pollutant, and product mass balances of production facilities

(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

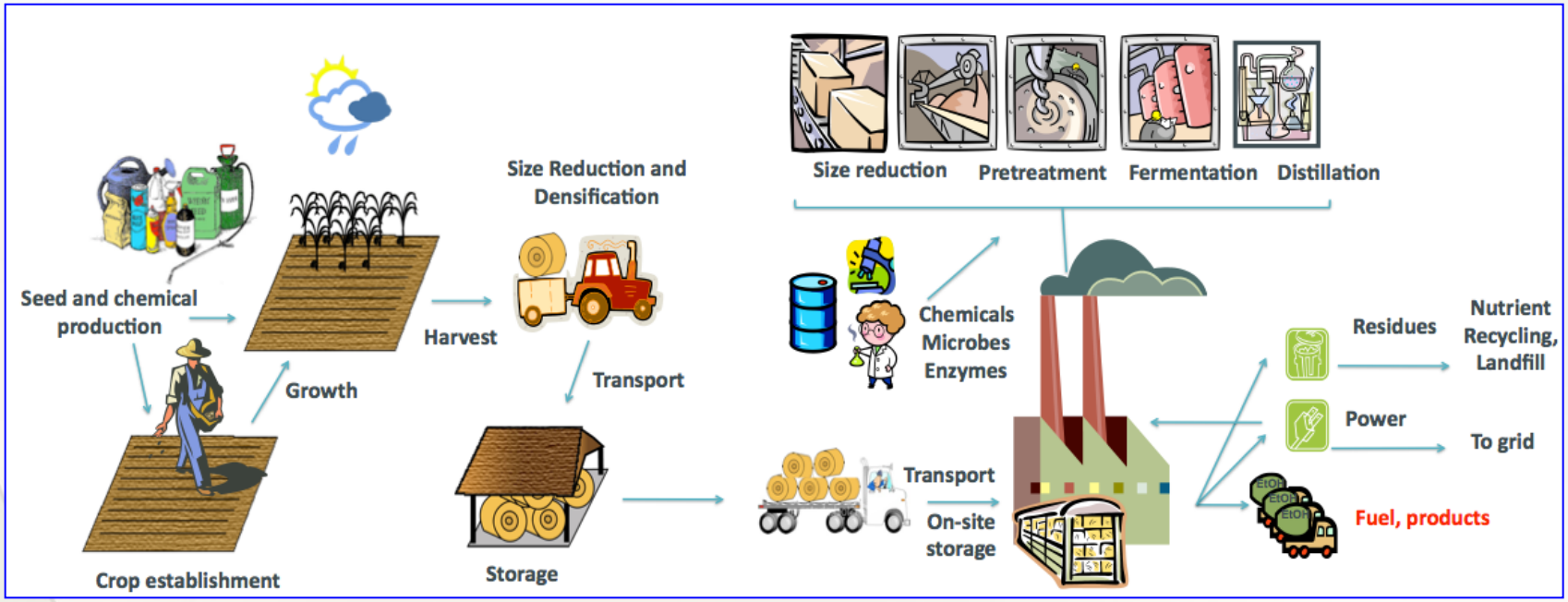
- Both advocates and critics of biofuels focus on a restricted set of scenarios to reinforce prior beliefs
- Even accomplished LCA practitioners tend to focus on system end-states
- We must also consider impacts that accrue during the transition phase

(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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