INTEGRATED ASSSESSMENT

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Global Climate & Energy Project

STANFORD UNIVERSITY

Technology Potential of Biofuels: Feasibility Assessment

Investigators

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Objective

Though energy from biomass is actively being considered as a low-carbon alternative to fossil fuels, three major unknowns limit our ability to accurately assess the potential contributions of biomass to future energy needs: (1) the total biomass resource that is sustainably available, (2) the costs (and possible ancillary benefits) of producing biomass for energy, and (3) the attainable efficiency of converting biomass resources into usable energy. This feasibility study will combine complementary perspectives from biogeochemistry and agricultural economics to explore novel approaches for answering the first two of these questions. The study results will provide upper and lower bounds on the potential magnitude of the biomass resource and the cost of producing it sustainably.

Background

The global biomass resource is very large. On an annual basis, terrestrial plant growth (also called net primary production or NPP) at the global scale is approximately 55 Pg C or nearly 10 times C release from fossil fuel combustion. The fact that NPP is much greater than fossil fuel combustion suggests a great potential for biomass as an energy resource. However, current biomass and NPP are loose constraints on the availability of biomass for energy generation. A more useful measure must include how much of the biomass resource is currently or potentially available and the extent to which technology can increase the size or availability of the biomass resource. This approach must consider competition for land, water, and nutrients, and the impact of technological advances such as genetic engineering on yield.

Approach

The investigators are utilizing a range of biogeochemical models, environmental data sets, and agricultural economics methods to project potential biomass production as a function of resource availability, plant species, management practices, and subsidies. Across the plant kingdom, the efficiency with which environmental resources (light, water, and nutrients) are converted into biomass follows consistent patterns across habitats, plant types, and management practices. These patterns are consistent enough to be reasonably modeled through simple responses to environmental resources. This consistency, updated with the most recent information on candidate biomass crops, provides a solid starting point for estimating potential biomass yields. However, for US croplands, the central question is the price for biomass that makes the land transition from food to energy production. This has been explored with integrated assessment models, but not with a sophisticated treatment of potential NPP and subsidy costs. The investigators will explore extending the food to biomass transition price in the context of changing global demand for food. For US lands withheld from cropping through subsidy programs, they will focus on the potential of these lands for biomass crops, with and without subsidies. The primary product will be an assessment of the potential for biomass production from US croplands as a function of biomass crop species and yield, the price of biomass energy, and the changing global food demand.

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