GCEP Final Report
Technology Potential of Biofuels: Feasibility Assessment
May, 2008

Investigators
Christopher B. Field, Professor, Biological Sciences
Rosamond L. Naylor, Senior Fellow at the Freeman Spogli Institute for International Studies and at the Woods Institute for the Environment
Elliott Campbell, Post-Doctoral Fellow, Biological Sciences

Interest and investment in biomass fuels is surging, but a series of papers published over the last few months has highlighted the environmental risks, and especially the climate risks, associated with unwise investments in biomass energy. These recent studies effectively frame the challenge of this project, which is defining the locations where biomass fuels can be produced in a way that effectively offsets warming and quantifying the amount of "climate-protective" biomass energy likely to be available. Our work is focused not on any particular technology for biomass energy production but on the ways and sites to utilize any of the relevant biomass energy technologies. Although biomass energy is topic of intense public and financial interest, three major unknowns limit our ability to accurately assess the potential contributions of biomass to future energy needs at the scale of the US or the globe. These are: (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. We are conducting a feasibility study to explore approaches for answering the first two of these questions. Our feasibility study combines biogeochemical modeling, plant physiology, and land-use analysis, with the goal of providing upper and lower bounds on the potential magnitude of the biomass resource and the cost of producing it sustainably.

In the project's first year, we published one paper, outlining our approach and setting an upper level for energy obtainable from biomass energy, under relatively strict constraints (Field et al. 2008). In addition, we developed a team and a proposal for a larger GCEP project. The larger project has now been funded, and progress on it is described in a separate report.

The striking result from the first paper (Field et al. 2008) is that the global potential for climate-protective biomass energy is limited. Using a conservative definition of the area available for biomass energy production as the global area used for agriculture sometime in the last 300 years but currently abandoned, we estimate an available area of 386×10^6 Ha. The likely net primary production from this land is about 1.2×10^9 ton C (Figure 1). If half of this could be harvested, the energy available content of the harvested material would be about 27 EJ or about 5% of global primary energy (Field et al. 2008).

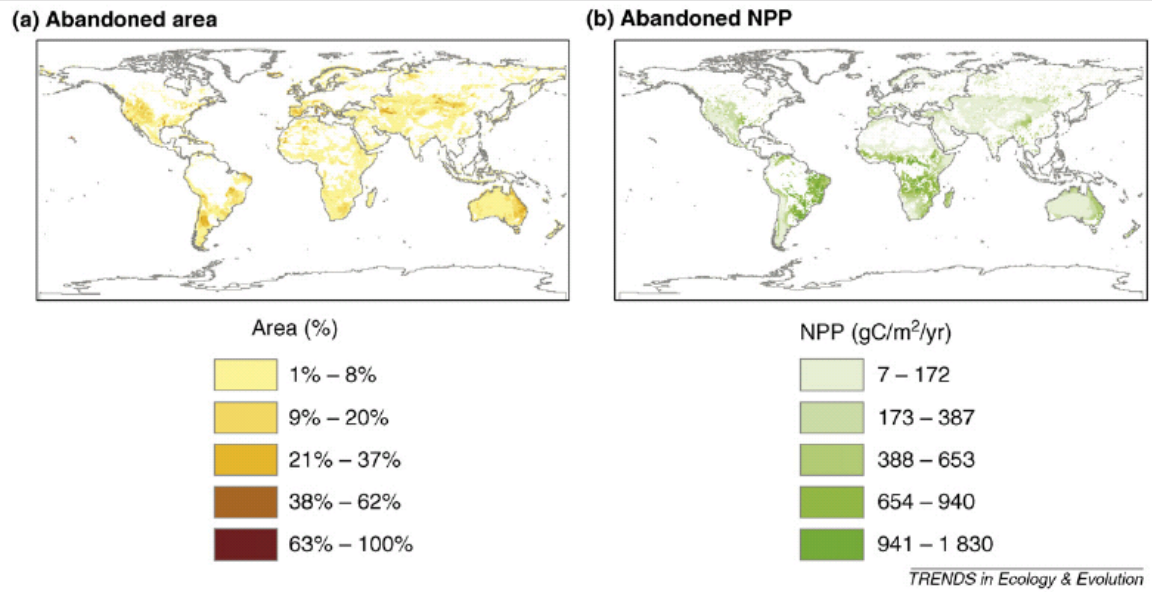

Figure 1: Figure 3. (a) Total abandoned land area, summing over abandoned crop and pasture and excluding areas currently covered by forests, urban area and areas converted from pasture to crops and (b) net primary production (NPP) on this land, from Field et al. (2008).

In addition to the publication and the grant for extending the biofuels work, our group is becoming increasingly involved in helping provide a scientific foundation for the increasingly political debates about biofuels. We have presented biofuels overviews at several events, including the 2007 GCEP annual meeting, and a 2008 Stanford Business school session on sustainable supply chains. We have discussed sustainable biofuels with leaders of biofuels activites at Shell, Chevron, and Ranch Capital (an owner of ethanol plants in Brazil). Upcoming presentations where one or more of our team is scheduled to discuss the GCEP project and present a biofuels overview include a Harvard Kennedy School executive discussion in Venice (May, 2008), a Princeton discussion on sustainable biofuels (June 2008), an earth System Science Partnership Biofuels Conference (Brazil, July, 2008), the Global Economic Symposium (Germany, September, 2008), and the SCOPE Rapid Assessment of Biofuels (Germany, September, 2008).

References

Field, C. B., J. E. Campbell, and D. B. Lobell. 2008. Biomass energy: the scale of the potential resource. Trends in Ecology & Evolution **23**:65-72.

Contacts

Christopher B. Field, cfield@globalecology.stanford.edu
Rosamond L. Naylor, roz@stanford.edu