

G.P. Robertson et al. Response to letters:

Sustainable Biofuels Redux Redux

We agree with S. Sechi's point that examinations of tradeoffs among sources of energy in general are needed. Recent analyses have concluded that a diversity of energy approaches is needed to meet future energy and climate stabilization demands, including conservation (e.g. 1,2). Thus it makes sense to examine tradeoffs and synergies among several approaches when possible. We do not assume that cellulosic biofuels are a *de facto* solution – especially considering sustainability issues; this is, in fact, the question at hand. We agree with her call for a consistent policy and her suggestion that the impact of agricultural supports be reevaluated.

We also appreciate B. Erickson's agreement with our call for a systems-level analysis of cellulosic biofuels at multiple scales. Regional to global scale analyses of net benefits and costs are crucial. Erickson also notes that "carbon debt" can occur when agriculture is expanded to meet increased demands for food and other products, including biofuels. But meeting new demand does not necessarily mean that large carbon debts are inevitable. What we know is that clearing natural ecosystems with large carbon stocks – especially forests growing on soils rich in organic carbon – releases much of the plant and soil carbon into the atmosphere as carbon dioxide. So we suggest that forest clearing for agriculture should be avoided whenever possible. We also know that carbon debt can be minimized or avoided if we can increase crop yields on lands already being used for agriculture (including degraded pastures) or on abandoned agricultural lands if we employ innovative management techniques, including the use of advanced biotechnology. A number of researchable questions about carbon debt remain to be answered. Our primary argument is that we should take the time and care to get it right from the start, and pay attention to early indications of environmental regret *and* synergy.

Finally, Ericson's inference that we favor "regulation of US biofuels in isolation" is mistaken on two counts: first, regulation is not the only policy tool available to promote environmental performance – incentive payments or subsidies based on avoided greenhouse gas emissions, for example, might be equally or more effective. Second, the global approach we advocate requires international cooperation – certification programs, for example, will work in a global economy only if applied equally to biofuels produced at home and abroad. Our basic contention is that for biofuels to become an environmentally acceptable part of the energy mix, they must be pursued in an environmentally sustainable way everywhere.

1. K. Caldeira *et al.*, in *The Global Carbon Cycle* C. B. Field, M. R. Raupach, Eds. (Island Press, Washington, DC, USA, 2004) pp. 103-130.
2. IPCC (Intergovernmental Panel on Climate Change). 2007. *Fourth Assessment Report, Working Group III Report "Mitigation of Climate Change"*. Cambridge University Press, Cambridge.

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