

First Comment on the UCB-UIUC Proposal to BP

Tad W. Patzek

*Department of Civil and Environmental Engineering
425 Davis Hall, MC 1716
University of California, Berkeley, CA 94720
Email: patzek@patzek.berkeley.edu*

Please Distribute Freely

March 8, 2007

Abstract

My 24-year old daughter Sophie, a molecular biology major, has provided perhaps the most succinct summary of the Energy Biosciences Institute (EBI) proposal: “Seriously, the scariest point for me made in the proposal is the fact that they know it will decrease the value of soil, which makes me think this is their way of ensuring loads of profit for a long time by selling special fertilizers, etc., and their thoughts that genetic engineering is the solution to world hunger, environmental degradation, and disease. I think people are fooled by bioengineering research because everyone publishes on the basis that their research will change the world through the action of some genetic manipulation. Haven’t we realized how many people have failed? If we can’t take care of ourselves naturally, how are we going to do it unnaturally? This proposal seems to reflect the strange American way of thinking that any problem can be fixed with a little god-like domination over nature (examples would include things like plastic surgery and biofuels). I mean their desire to play god and in the meanwhile make profit is almost child-like. We are not living in a world of monopoly money where there are no consequences to your actions!” Sophie does genetic and biomedical research and is not related to Berkeley or BP.

1 Mine Biomass Forever with No Consequences

It can be shown that the Earth is too small and fragile to fulfill the grandiose promises from Berkeley, BP, DuPont, Monsanto, Mendel Biotechnologies, Amyris Biotechnologies, Savia, ADM and Cargill, abbreviated here as EBI. Therefore, the rest of the proposed research may be interesting and it may enrich handsomely the principal investigators, but the University of California, Berkeley, has been chartered by the State of California to serve the public, not merely enrich individuals and corporations. In addition, Berkeley cannot become an accomplice to the wanton destruction of the priceless ecosystems in Brazil, Argentina, Columbia, Guatemala, Indonesia, Myanmar, equatorial Africa, and others. This destruction is already taking place, and several of the EBI players have been implicated.

Recently, the USDA and DOE produced an analysis of where the feedstocks for a bioenergy industry can be obtained. This document proposed that a majority of the

feedstock would be derived from crop residues, but that a significant proportion would be obtained from dedicated energy crops. We believe that the EBI should be agnostic about the relative contribution of dedicated energy crops vs. crop residues, and must have expertise in subjects that cover both (Energy Biosciences Institute (EBI) Proposal, Page 36).

Today it is commonly believed that burning freshly cut plants is morally superior to burning old fossil plants. Even more curiously, some are convinced that stripping ecosystems of gigantic quantities of biomass can go on year-after-year, forever, and with no consequences. This attitude is best exemplified by the DOE/USDA report by PERLACK et al. (2005) which claims that “. . . An annual biomass supply of more than 1.3 billion dry tons can be accomplished with relatively modest changes in land use and agricultural and forestry practices.”

Based on this report others, e.g., Mr. VINOD KHOSLA proclaimed¹: “Or *we could produce* 130 billion++ gallons *of ethanol*² per year!” Unfortunately, this is impossible for much more than one year regardless of technology.

To arrive at its conclusions, the DOE/USDA report made the following assumptions:

1. Yields of corn, wheat, and other small grains were increased by 50 percent;
2. The residue-to-grain ratio for soybeans was increased to 2:1;
3. The harvest technology was capable of recovering 75 percent of annual crop residues;
4. All cropland was managed with no-till methods;
5. 55 million acres of cropland, idle cropland and cropland pasture were dedicated to the production of perennial bioenergy crops;
6. All manure in excess of that which can be applied on-farm for soil improvement under anticipated EPA restrictions was used for biofuel; and
7. All other available residues were utilized.

With a little thought and few calculations, these assumptions can be readily disproved, see **Figure 1**:

1. The permanent 50 percent increase of all crop yields is impossible. The all-time record yield of corn in 2004, 160.1 bushels/acre, was followed by 147.9 bu/acre in 2005, and 149.1 bu/acre in 2006. The real yields have been decreasing instead of jumping up by 50 percent. If in the next couple of years La Niña sets in, the ensuing drought in Midwest will make these yields quite high in comparison. One may look at Australia today for the effects of a major drought on crop productivity.
2. The 2:1 residue-to-grain ratio for soybeans would require a 45 percent increase of the current average harvest index of 0.42, and is not quite achievable.
3. Taking most residues from the fields would leave little or no plant matter to protect the soil from excessive wind and water erosion. The rate of erosion in US agriculture generally exceeds the rate of soil mineral deposition and humus generation.

¹VINOD KHOSLA’s presentation, *Biofuels: Think outside the Barrel*, April 2006.

²The text added by T. W. Patzek is in italics.

4. Total no till agriculture would require astronomical quantities of herbicides and pesticides to kill off the “spurious” life competing with the resource-greedy, but otherwise delicate hybrid crop monocultures. Because of the comprehensive loss and poisoning of the natural environment and imported parasites, the honeybee population declined by 60% between 1947 and 2005. Honeybees had to be imported from outside North America last year for the first time since 1922. Bees pollinate an estimated 10-20 billion dollars worth of crops every year.
5. US corn grows on over 70 million acres. Dedicating 55 million acres to *Miscanthus* grass or switchgrass would eliminate plenty of other crops. The total area of the soil Conservation Reserve Program (CRP) in the US is a modest 34 million acres.
6. The EPA requirements are perceived as restrictions. In other words, a modicum of conservation is viewed as an obstacle to feeding our thirsty cars and all remaining land (see Item 5) must go.

One simply cannot remove biomass and nutrients from an ecosystem without putting these nutrients back, protecting the soil structure, and suffering from lower yields in later crop rotations in industrial plantations. The high heating value (HHV) of 1.3 billion tons of biomass is roughly 22 EJ; and the HHV of 130 billion gallons of ethanol is 11.4 EJ. The fictitious DOE energy efficiency of converting biomass to ethanol, $11.4/22 = 0.52$, corresponds to Fischer-Tropsch synthesis and is two times higher than efficiency of the current corn-ethanol process. If one were to produce cellulosic ethanol with a 26% efficiency, one would have to use all above-ground biomass of all US crops, pastureland and rangeland, and annual biomass growth over 2/3 of all US forestland and timber plantations, see Figure 1.

In summary, the DOE/USDA – and now Berkeley’s – vision is to capture in real time most of net growth of all biomass in the US, while at the same time mining soil, water, and air over 72 percent of our land area, including Alaska, Hawaii, and Puerto Rico. This biomass would then be devoured to feed our inefficient cars. We would have little food production, as well as little wood for paper and construction. In effect, the new brave US economy would be dedicated to feeding cars, not people. This vision seems to have been endorsed enthusiastically by the EBI proposal Principal Investigators.

As a result, the EBI proposal offers to research these time-tested solutions of industrial agriculture³:

1. Develop even bigger monocultures, preferably dedicated energy crops, and best of all the ones that might directly enrich some of the PI’s through their private corporation⁴.

³Pages 36 and 40.

⁴Mendel Biotechnologies, Inc., has Dr. CHRIS SOMERVILLE as Chairman and Dr. BRIAN STASKAWICZ as a Board Member. Their company sells *Miscanthus* grass, so the EBI proposal is filled with research on that grass. Mendel’s most important single customer is Monsanto Corporation, the leading agricultural biotechnology company in the world. Approximately 90% of the transgenic plants grown on more than 100 million acres worldwide contain technology owned by Monsanto. In the spring of 2002, Mendel entered into a five-year \$20 million dollar research and development agreement with Monsanto. Under the terms of the agreement, Monsanto has the right to obtain royalty-bearing licenses to Mendel technology in certain large-acreage crops. This agreement followed an earlier \$26 million dollar, four-year, agreement with Monsanto and Savia based on a similar concept. Under the agreement, Monsanto also provided Mendel with commercial rights to technologies that permit rational genetic improvement of plants. The interests of Mendel and Monsanto are highly aligned and the companies have established very effective mechanisms of collaboration, including the exchange of extensive proprietary information from Monsanto’s internal research program. Source: Mendel Biotech Website, accessed on March 4, 2007

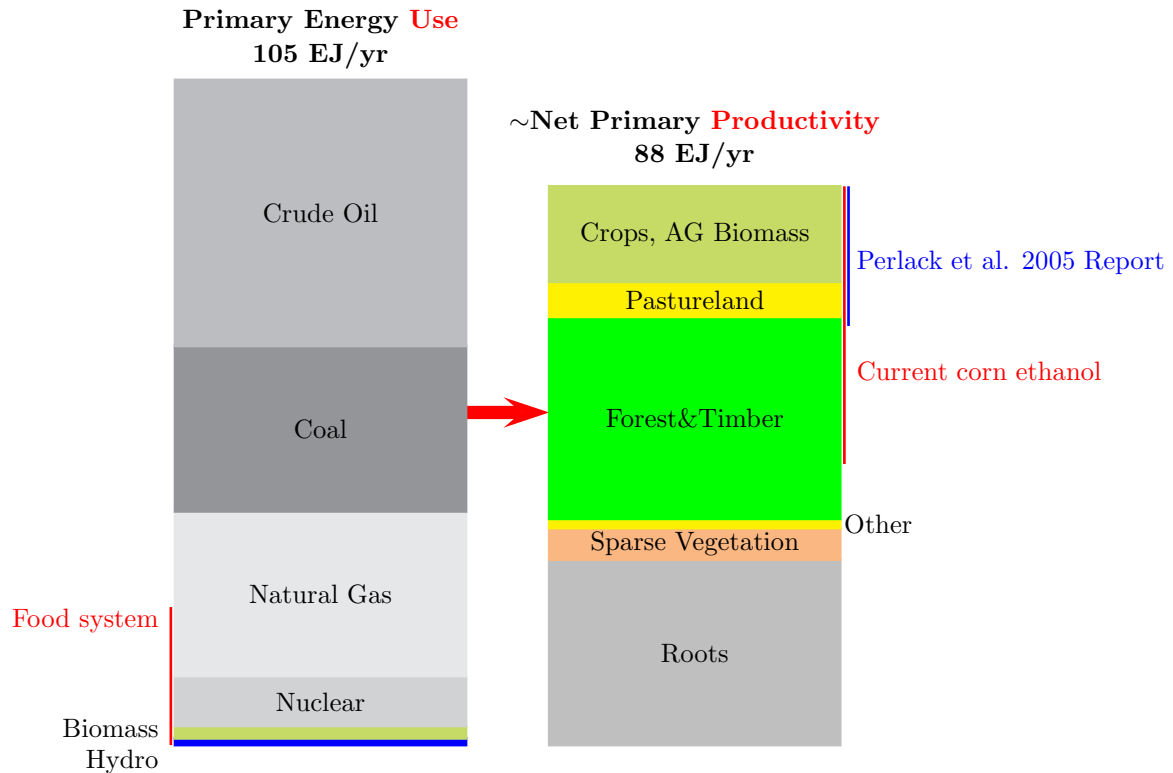


Figure 1: Annual fossil and nuclear energy consumption in the U.S. is now larger than *all* biomass yield over its territory. Sources: EIA; USDA NASS; GOOD & BELL (1980); PATZEK, 2006 calculations. **Left:** Primary energy use in the U.S. in 2004. Biomass burning provided about 2 percent of primary energy supply. **Right:** A very optimistic estimate of annual net biomass production over the entire U.S. area in 2004. This biomass production has been converted to equivalent energy. Over 3/4 of the biomass production is committed to food and animal feed, wood for paper, lumber and fiber, or is energy stored in plant roots and other inaccessible parts. This part of biomass production is *heavily subsidized* with fossil fuels. One half of the remainder is remote and sparse vegetation. The remainder may serve as the source of energy, but a large part of it will be used to produce biofuels. So the ultimate sustained biofuel production capacity in the U.S. is 2-3 percent of U.S. energy consumption *today*. At its unrealistic conversion efficiency, the DOE (Perlack et al., 2005) proposal would require us to dedicate all above-ground biomass production from all US cropland, pastureland and rangeland. In 2004, crop production in the US posted an all-time record. With a more realistic process efficiency of the current corn ethanol production (Patzek, Natural Resources Research J., **15**(4), 2006), one would also have to devote most of net timber production to biofuels. Of course, this is impossible.

2. Work with commercial seed companies⁵ to get better patented seeds.
3. Study maize germplasm to detect effects of stover removal on subsequent yields⁶.
4. Check how much more fertilizers one needs to put in the fields to ensure consistently high yields.
5. Identify efficacious agrochemicals⁷ to fight the inevitable pests and pathogens.
6. Register these agrochemicals for use on energy crops⁸.
7. Investigate the possible side-effects of energy crops⁹.

1.1 Action Items

It seems that there exist:

1. Serious scientific, ethical, and moral issues related to the EBI programs described above.
2. Blatant conflict of interest characteristic of the discredited Novartis-Berkeley deal. For example, Drs. CHRIS SOMERVILLE, SHAUNA SOMERVILLE, and STASKAWICZ seem to have at least a 20,000,000 dollars conflict of interest as academic researchers.
3. Possibility that new potent agricultural poisons will be registered by the University of California, Berkeley. The major beneficiaries of these agrochemicals might be Monsanto, Savia and Mendel Biotechnologies, Inc., as well as BP's commercial partner DuPont.
4. Certainty of development of commercial, radically genetically modified plants and organisms to be released into the global environment by the same companies.

These serious flaws of the EBI Proposal must be rectified.

1.2 Next...

Comments on the inevitable expansion of EBI-related activities to the tropics and the ensuing CO₂ emissions.

⁵Many farmer and environmentalist groups accuse Monsanto of attempting to monopolize and colonize farming in the Third World. Already, about 10 companies worldwide hold 30 percent of the annual \$23 billion commercial seed trade, and genetically modified crops are virtually controlled by only four companies: Monsanto (US), Syngenta (Switzerland), Aventis (France) and the DuPont (US), according to Research Foundation for Science, Technology and Ecology.

⁶The science in this particular EBI project reminds me of a scientist studying the ability of frogs to jump. When this scientist cut off all four legs of a frog, he concluded that the frog went deaf because it would no longer respond to his order: "Jump!"

⁷Since vast plant monocultures attract specialized pests and pathogens, and their productivity *always* declines, ever more potent agrochemicals – herbicides, pesticides and fungicides – are needed every few years. The Lead PI on this project is Dr. STASKAWICZ of Item 1 and Dr. SHAUNA SOMERVILLE is a collaborator.

⁸Registering a new agrochemical through a public university helps to insulate its future corporate producers and users from legal liability.

⁹These effects are caused by stripping the soil naked from any protection for 8 months a year and exacerbating the existing severe problems with agricultural soil erosion by water and wind, nutrient depletion, and soil structure damage by killing off the soil's fauna and flora with the efficacious agrochemicals. The US land, mostly agricultural, loses about 700 million tonnes of soil per year. When I spoke to a group of farmers in Pennsylvania about corn stover collection, one farmer thought that I was for it, and interrupted me by shouting loudly: "Mister, you don't know what you're talking about. I would be mad if I gave them my stover!"

References

Perlack, R. D., Wright, L. L., Turhollow, A. F., L., G. R., Stokes, B. J., and Erbach, D. C. 2005, *Biomass as feedstock for a bioenergy and bioproducts industry: The technical feasibility of a billion-ton annual supply*, Joint Report, Prepared by U.S. Department of Energy, U.S. Department of Agriculture, Environmental Sciences Division, Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge, Tennessee 37831-6285, Managed by: UT-Battelle, LLC for the U.S. Department of Energy under contract DE-AC05-00OR22725 DOE/GO-102005-2135 ORNL/TM-2005/66.