

To: spaley1ams@aol.com  
Sent: Wed, 26 Sep 2007 11:27 am  
Subject: Cellulosic ethanol

Mr. Paley,

I just read your article, "Coupling Carbon Sequestration with Novel Cellulosic Ethanol Technology", and have a question.

Why would the used algae have to be dumped into the sea instead of processed like the other biomass into cellulosic ethanol?

The carbon dioxide could then feed more algae to provide more biomass for the process.

Dear --

You are correct. Theoretically one could do this a number of times in an iterative fashion. In fact, one of our group has proposed a specific technique for stimulating the growth of algae on the oceans and then harvesting them for use as biomass. However, in the end we want to sequester the carbon for at least millennia so that the carbon does not reenter the atmosphere as CO<sub>2</sub>.

If one captures the copious amounts of CO<sub>2</sub> given off during the manufacture of many biofuels, and also uses a biomass that requires little or no cultivation (i.e., carbon input) then one can show that more carbon dioxide is removed from the atmosphere during photosynthesis than is put back by turning the biomass into biofuel and then burning it. That is, the biofuel is now carbon negative and this procedure can now be used to remove net carbon dioxide from the atmosphere as a palliative for global warming as well as to produce suitable biofuels.

Furthermore, since the fuel is now carbon negative in the above sense it can now be burned everywhere without having to collect the CO<sub>2</sub> at the various locations where it is burned -- unless one wishes to remove even more net CO<sub>2</sub> from the atmosphere. The only place where the CO<sub>2</sub> need be collected is at the biofuel manufacturing facilities. This last point is important because, as a practical matter, it would be logistically almost impossible to capture the CO<sub>2</sub> at all the places where biofuels (with the advances I describe in the article) will ultimately be burned, and then collect and dispose of the dead algae at sea.

If one can get the dead algae past the 3,000 foot level at sea the carbon they contain should remain sequestered for millennia or even longer. During the initial 3,000 feet, however, there are organisms that will consume up to half the algae and recycle their carbon, short term, back into the atmosphere as CO<sub>2</sub>. We have made practical low cost, energy conserving suggestions for transporting the dead algae and then getting them below the 3,000 foot level of ocean without the algae being partially consumed.

The particular ethanol production process that I describe in the article, microorganism mediated cellulosic ethanol production, has an energy gain of about 11, produces almost no pollution during manufacture of the ethanol and is the first low cost, desirable replacement for energy applications of oil without any meaningful negative tradeoffs. And we can replace all oil imported into the US with biomass grown on less than 10% of the acreage currently devoted to US agriculture; i.e., there is no need to trade off growing food versus biomass to make biofuel. Thus, to the extent that ethanol made with this process replaces gasoline we not only are producing a "carbon negative" fuel but also getting rid of one of the most carbon positive enterprises on earth -- the oil industry together with all its support industries and technologies.

For a variety of reasons having nothing to do with technology it is now problematical as to whether this process/system, or others than are capable of making large (beneficial) changes, will ever be commercialized and deployed, but that is another matter. PLEASE SPREAD THE WORD AS FAR AND AS WIDE AS YOU CAN!

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