Cellulosic Biofuels: A Strategic Perspective
Lee Lynd

Of the various forms of terrestrial plant matter, cellulosic biomass is widely seen as having the greatest potential for large-scale energy production due to cost, environmental, and scale-of-supply considerations. Key factors that impede cellulosic biofuels playing a large role in meeting mobility demand are: 1) the currently high cost of cellulosic biofuels; 2) collective uncertainty about whether meeting a substantial fraction of mobility demand with cellulosic biofuels can be compatible with feeding the world, lowering carbon emissions, and sustainable land use.

The high cost of cellulosic biofuels produced via current technology – impediment 1 - is in general attributable to the high cost of processing, rather than the high cost of feedstock, and is in particular due to the high cost of converting cellulosic biomass to reactive intermediates ("overcoming recalcitrance") rather than the cost of converting reactive intermediates to fuels. Consolidated bioprocessing (CBP), featuring hydrolysis and fermentation of cellulosic biomass in one step without added enzymes, is widely considered to be the ultimate low-cost configuration for cellulose hydrolysis and fermentation" (joint DOE/USDA roadmap, 2007). Mascoma is the leading company pursuing CBP, building on the premier position of the Lynd lab.

Key observations relative to land use issues – impediment 2 – include:

• The production and utilization of cellulosic biofuels could have many positive environmental attributes measured on a per-unit basis (e.g. per ton, per mile, per acre), including but not limited to potential for very large reductions in greenhouse gas emissions. The main environmental challenges related to biofuels arise not from direct per-unit impacts, but rather from often indirect results of the number of units processed, that is the scale of production.

• For all resources and all end-use sectors, paths to a sustainable world feature multiple, large, complementary changes, many of which may not be probable today. Approaching the future in terms of extrapolating the present, or single changes to the status quo, does not illuminate viable paths to a sustainable world.

• Due to energy density considerations, a significant fraction of the transportation sector is very likely to be powered by organic fuels for the indefinite future. As the only foreseeable sustainable source of organic fuels, biofuels are a non-discretionary part of a sustainable transportation sector.

• There are many strategies by which large quantities of cellulosic biofuels can likely be produced without decreasing food production, significant carbon emissions from land use change, and habitat loss. These involve multiple, large, complementary changes, but that should come as no surprise.