Biomass Refining in Response to Sustainability and Security Challenges

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Abstract

The major sustainability and security challenges we face arise primarily from energy use. Thus in order for biomass refining is to play more than a minor role in responding to these challenges, it must make a significant impact on energy production and utilization. This presentation examines this possibility. Mature technology is emphasized, since questions such as the potential of biomass to address societal needs and appropriate levels of support for biomass-related research and development are impacted more by what technology could become in the future than by what it is today. Cellulosic feedstocks are emphasized because of productivity, environmental, and cost advantages as compared to other sources of biomass. The results presented stem from a multi-institutional project entitled “The Role of Biomass in America’s Energy Future”.

Mature processing technology scenarios for cellulosic biomass will be presented based on detailed computer (ASPEN) models. These include stand-alone production of power, Fischer-Tropsch (FT) fuels, and hydrogen, as well as coproduction scenarios involving ethanol-power, ethanol-power-FT fuels, ethanol-hydrogen, ethanol-FT fuels-natural gas, and several of these product combinations in conjunction with feed protein. Working hypotheses will be presented regarding product combinations that are particularly promising from the point of view of economic, thermodynamic, and environmental efficacy. Our results suggest that both the overall attractiveness of biomass processing as well as the attractiveness of several specific product combinations increase markedly when viewed in the context of mature technology as compared to current technology. In particular, we project that some mature processing technology scenarios will have overall efficiency (heating value of products/heating value of biomass) in excess of 70% and be economically competitive with conventional processes based on fossil resources at prices seen over recent years.

Analysis will be presented addressing the question of the sufficiency of biomass resources in relation to meeting needs for large-scale energy services such as transportation. We find that a very large range of answers to this question are possible. Key variables impacting the extent of biomass resource sufficiency include whether future R&D-driven advances in biomass productivity are considered, the level of assumed maturity (and hence efficiency/yield) of conversion technology, end-use (e.g. vehicular) efficiency, and the extent to which coproduction of feedstocks for energy is carried out on already managed lands. Given favorable values for most of these variables, which are very likely possible to achieve given a collective will do so and can be expected to be favored by market forces in several cases, biomass could potentially make a very large contribution to meeting demand for energy services. For example, our analysis supports the possibility of a U.S. transportation sector supported mostly and perhaps entirely by biomass without allocating any new land beyond that already devoted to agriculture.