ARE LIGNOCELLULOSIC RESOURCES TOO VALUABLE TO BURN?

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Lignocellulosic matter often can be counted as a renewable resource, since it is produced by photosynthesis. But there are limits to how much biomass our society can use in a sustainable manner. People can debate whether or not it makes sense to use a substantial portion of lignocellulosic materials as a source of liquid fuel. This essay gives a qualified affirmative answer to the question in its title. However, combustion of lignocellulosic resources can be considered as wasteful and uneconomical, in the long run, if it is inefficient, if it fails to displace the combustion of fossil fuels, or if it displaces a higher-end use, for which there are available customers. In particular, it seems unlikely that combustion of fuels derived from lignocellulosic biomass can, by itself, solve problems that stem from society's excessive thirst for motor fuels.

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HIGH-VALUE USES OF LIGNOCELLULOSIC RESOURCES

The pages of this journal, *BioResources*, include many research articles that describe how lignocellulosic resources can become converted to relatively high-value products and structures. Other articles describe ways to extract the energy content from lignocellulosic biomass – for instance in the form of liquid fuels for powering motor vehicles. At some point, these latter uses tend to compete for a limited, though renewable set of resources. In this context the question is worth asking, whether lignocellulosic resources, in general or specifically, may be too valuable to burn.

To be specific, some higher-value uses of lignocellulosic resources discussed in these pages have included the following: *BioRes.* 1(1): paper products, oriented strand board: *BioRes.* 1(2): particle-board, composites, dialysis membranes; *BioRes.* 2(1): textile fibers, adsorption of toxic heavy metals; *BioRes.* 2(2): activated carbon, nanofibers, solid wood properties, component of an adhesive; *BioRes.* 2(3): plant growth enhancement, nanocomposite; *BioRes.* 3(1): sorption of heavy metal ions, treated solid wood, etc., etc.

"DUMPING" OF LOW-VALUED LIGNOCELLULOSIC RESOURCES

Presently a large proportion of the available cellulosic resources are "dumped." Either they are landfilled, burned on site, or thrown into piles not suitable for composting.

Examples include the landfilling of paper products, piles of brush cast aside in the forest (by-products of timber harvesting), excess agricultural wastes (when they aren't used for composting), and rubble from tearing down or renovating buildings. Moghtaderi *et al.* (*BioRes.* 1(1), 105-127) discussed various underutilized classes of cellulosic biomass.

REASONS TO CONSIDER MOTOR FUEL AS A PREMIUM PRODUCT

As was noted in a review article (*BioRes.* 1(1), 150-171), one can consider motor fuels to be highly engineered, premium products. They are designed to meet exacting specifications, delivering dependable power, lubrication, and clean running over a wide range of temperature and operating conditions. Recent upward excursions in price are a continual reminder to us of how dependent upon motor fuels we have become. The word "burn," as used in the title of this essay, can suggest a careless oxidation of biomass, as in the case of a campfire. In contrast to the inefficiency of a campfire, in technical terms, one might argue that motor fuels do their "job" of turning engines in an extremely effective and dependable way. On the other hand, it is easy to believe that much higher miles-per-gallon could be achieved either through legislation or higher prices.

TOO VALUABLE TO BURN, WHEN THERE ARE OTHER USES

In light of these thoughts, the answer to the title question (Are lignocellulosic resources too valuable to burn?) should be a qualified "yes." Yes, these resources are indeed "too valuable to burn" if they are combusted in an inefficient way, especially if such burning does not displace an equivalent amount of fossil fuel. The answer also is yes if there are customers and processes available for many alternative uses, such as those outlined by many authors of articles in this journal. Also, the answer probably should be "yes" if the questioner has pinned hopes of solving the energy crisis by sole reliance on biofuels. There simply is not enough excess cellulosic biomass to meet the projected needs for fuel in the long term. The book *Energy for the 21st Century* by Roy Nersesian (Sharpe, 2007) explains the sustainable limits of biomass production. Maybe the best answer is to think of motor fuels as a possible "default" bi-product, the kind of bi-product that can fill out the portfolio of products from a well designed and optimized biorefinery.

Another way to answer the question is to examine some of the *other* most likely ways to meet the increasing demands for motor fuels and other forms of energy. Some of the most promising approaches include direct solar, passive solar (especially for heating), wind, hydroelectric, and geothermal. Perhaps even more important, in terms of solving short-term problems, will be improvements in efficiency, including increased use of public transportation, electric vehicles, and low-energy housing. Maybe it is better that those houses be made with wood, representing high-end uses, rather than that either they or the vehicles parked in the driveways be fueled mainly with lignocellulosic byproducts. If too much of the lignocellulosic biomass is used as fuel, then not enough of the resource may remain for various higher-value applications.