

BIOCHEMICALS



In cooperation with the US
Department of Energy



Organic chemicals, which are widely used in our everyday lives, are some of the highest value products that can be made from biomass resources. Additionally, the potential for production of organic chemicals from biomass is also quite large. There are at least 1,700,000 known organic compounds with more being discovered almost daily. In comparison, there are about 500,000 inorganic compounds.

Prior to the 1940's, most chemicals were derived from plant materials. However, once fossil fuels became readily available and inexpensive, and the technology for refining and processing them became developed, most organic chemical production shifted to fossil-based resources.

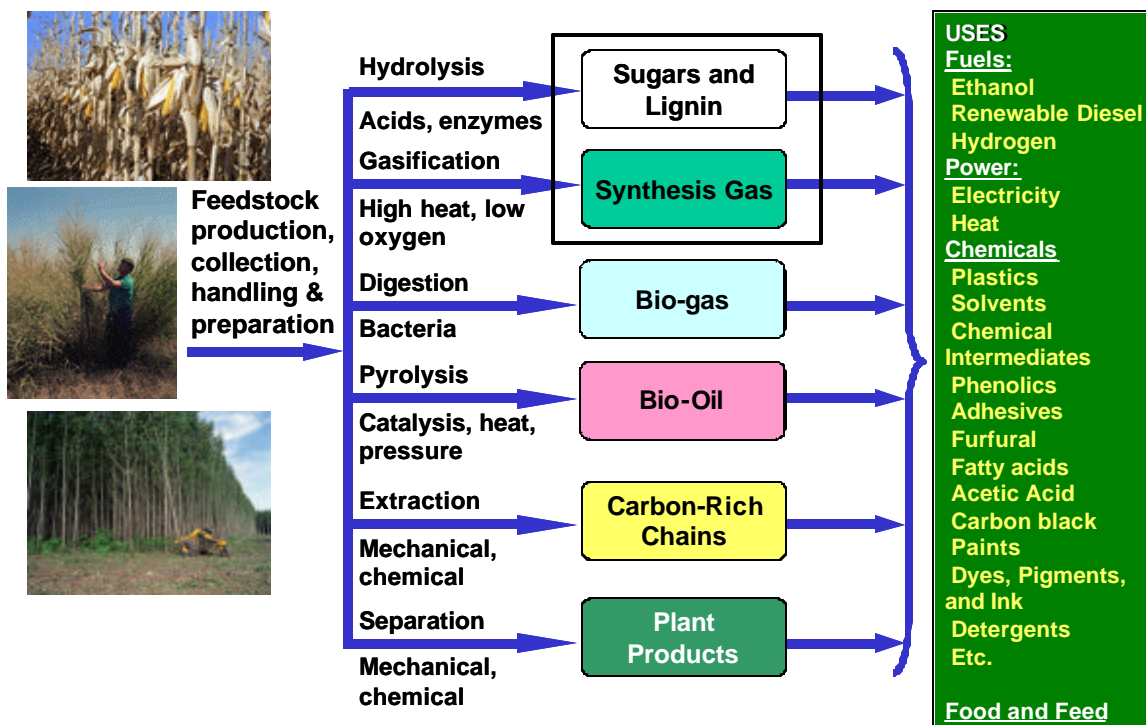
Since petroleum was derived from plant materials, the chemical composition of biomass and petroleum is quite similar. As a result, *anything that can be made from petroleum can be made from biomass*. Today, many important chemicals are manufactured from organic materials including various plastics and other products.

The basis for today's petrochemical industry consists of seven basic building blocks, from which all organic compounds can be obtained¹. Currently, these building blocks are all obtained from natural gas, petroleum, and coal. However, the potential for biochemical production and the accompanying economic development is large. The United States chemical industry is currently the world's largest producer of all chemicals, accounting for about 25% of the worldwide market. In 1995 this production was valued at \$367 billion to the US economy. The US chemical industry also has the largest trade surplus of all US industry sectors; chemical manufacturing is the third largest manufacturing sector in the US and represents about 10% of all US manufacturing. Currently, about 95% of the 50,000 chemicals manufactured in the US are made from fossil resources.

Until recent times, the price of petroleum was so low that it was difficult to cost effectively produce chemicals from biomass. However, the increased price of petroleum has opened new opportunities for biomass. Oil at \$60 per barrel is equivalent to \$0.18 per pound. In contrast, biomass at \$70 per dry ton is equivalent to \$0.035 per pound, thus *raw biomass costs five times less than petroleum and is locally produced*. A price of \$70 per dry ton (\$35 per green ton) is an upper limit for pulpwood prices in the Southeast US and these prices are currently falling as worldwide competition is hurting American pulp and paper production. In many cases in the southeast pulpwood can be obtained for as low as \$30 per dry ton.

Additional research and development will also help bring down the cost of processes that can convert biomass into chemicals. One way to reduce production costs is through the development of **biorefineries**. Like their petroleum refinery counterparts, biorefineries use a variety of methods to separate the biomass into its highest value components and strives to use as much of the biomass as possible. This procedure maximizes the value of the biomass and minimizes residues and environmental cleanup.

¹ The seven basic building blocks from which most organic compounds can be obtained are syngas from methane, ethylene, propylene, butanes, butylenes, butadiene, and BTX (which is a mixture of benzene, toluene, and xylene).



The figure above shows some options for an integrated biorefinery as envisioned by the U.S. Department of Energy Office of Biomass Program. The U.S. Department of Energy has major research programs working on ways to convert paper manufacturing plants into biorefineries. This action is being taken because increasing global competition is threatening the US pulp and paper industry. However, these US facilities have the expertise and infrastructure in place to handle large quantities of biomass. Thus by also making or recovering value-added products from the wood and then making paper out of the rest, the plants can become competitive again. Since the overseas competition is investing in current technology, the US industry can leapfrog their foreign competition by developing and implementing this new technology.

Although in the past it has been more cost effective to produce most organic chemicals from fossil fuels, any organic chemical can also be produced from biomass; and fossil resources are becoming increasingly expensive. Thus the development of more cost effective processes for producing organic chemicals from biomass, coupled with the increasing price of fossil fuels, will significantly expand the opportunities for organic chemical production in the United States.

This series of fact sheets was prepared by the Southeast Biomass State and Regional Partnership (formerly the Southeastern Regional Biomass Energy Program). The Partnership is one of five regional administrations of the U.S. Department of Energy's (DOE) National Biomass State and Regional Partnership. The Partnership was established in 2003, and is managed for DOE by the Southern States Energy Board. The goal of this Partnership is to work cooperatively with the DOE Office of Biomass Program's (OBP) to facilitate the increased use of bioenergy and biobased products through coordinated federal, regional, and state outreach, education and technical assistance programs.

Partnership Project Staff

Kathy Baskin, Project Manager Southern States Energy Board 6325 Amherst Court Norcross, GA 30092 (770) 242-7712 (770) 242-9956 fax baskin@sseb.org	Phillip Badger, Technical Mgr General Bioenergy, Inc. 3115 Northington Court Florence, AL 35630 (256) 740-5634 (256) 740-5635 pbadger@bioenergyupdate.com
--	---