U.S. BILLION-TON UPDATE

Land-Use Change*

Summary of Findings

The 2011 *Billion-Ton Update* estimates land-use change from cropland and pastureland into energy crops under different yield and feedstock farmgate prices. Under baseline assumptions, up to 22 million acres of cropland and 41 million acres of pastureland shift into energy crops by 2030 at a simulated farmgate price of $60 per dry ton. This land-use change is similar in magnitude to the 40 to 60 million acres in energy crops reported in the 2005 *Billion-Ton Study* (2005 *BTS*). At lower simulated prices, total crop and pasture land-use change is much less—about 5.6 million acres at $40 per dry ton and 27 million acres at $50 per dry ton. At the lowest simulated price, land-use change is limited to cropland. Higher simulated farmgate prices move energy crops onto pasture. At this level of land-use change, total feedstock production ranges from 34 to 400 million dry tons at simulated prices of $40 to $60 per dry ton, respectively.

Under high-yield assumptions, with a 4% annual increase in energy crop yields, greater amounts of cropland and pastureland shift into energy crop production. Up to 30 million acres of cropland and 49 million acres of pastureland shift into energy crops by 2030, at a simulated farmgate price of $60 per dry ton. At the lower simulated farmgate prices of $40 and $50 per dry ton, total land-use change is 33 and 44 million acres, respectively. Over the $20 per dry ton simulated feedstock price range, year 2030 total energy crop production is 261 to nearly 800 million dry tons in 2030.

Photo courtesy of ORNL

Total crop and pasture land-use change for the baseline and high-yield scenarios at a farmgate price of $60 per dry ton

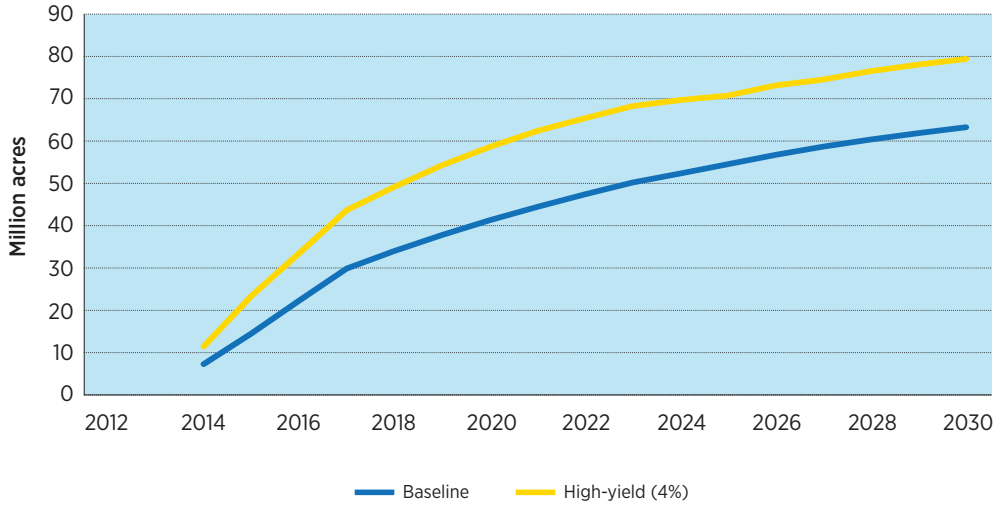

Illustration courtesy of BCS Inc.

*This fact sheet refers to the following document: U.S. Department of Energy. 2011. *U.S. Billion-Ton Update: Biomass Supply for a Bioenergy and Bioproducts Industry.* R.D. Perlack and B.J. Stokes (Leads), ORNL/TM-2011/224. Oak Ridge National Laboratory, Oak Ridge, TN. 227p. Download the full report at eere.energy.gov/biomass/pdfs/billion_ton_update.pdf. View the report, explore its data, and discover additional resources at bioenergykdf.net.

Additional Information

Prospective land-use change is estimated using POLYSYS, a policy simulation model of the U.S. agricultural sector. In POLYSYS, land is allocated to the commodity crops and energy crops based on relative crop profitability in preceding years. The model also contains allocation rules or flexibility constraints that limit the amount of land a given crop can lose or gain each year.

These restraints are imposed to simulate the relative inelastic nature of agriculture in the near-term. For example, only 10% of cropland can convert to energy crops each year. The total amount of cropland in any given county that can convert to switchgrass or woody crops is limited to 25%. This restraint serves to maintain crop diversity. Similar restraints are imposed for cropland and permanent pasture. In addition, pasture can only convert to energy crops in regions where there is adequate moisture to intensify pasture to make up for lost forage. Generally, POLYSYS allows pasture conversion only in counties east of the 100th Meridian and when energy crop net returns are greater than pasture rental rates, plus additional costs for intensifying remaining regional pasture to make up for lost forage.

The land base in POLYSYS includes about 250 million acres planted to the eight major crops, 61 million acres of land in hay production, 23 million acres of cropland used as pasture, and 117 million acres of non-irrigated permanent pasture. Although total U.S. acreage in cropland pasture and permanent pasture is approximately 36 and 409 million acres, respectively, POLYSYS explicitly excludes pasture in counties where there is extensive use of supplemental irrigation and pasture west of the 100th Meridian. This land base was assumed constant throughout the modeling period. The analysis did not account for any competition and potential losses (or gains) of land to other major land uses, such as the conversion of pastureland to urban uses and the conversion of forestland to cropland. The analysis did not include land currently enrolled in the Conservation Reserve Program (CRP) or land that might become available as contracts expire. This update, as well as the U.S. Department of Agriculture projections, assume the approximately 32 million acres currently enrolled remain in the CRP throughout the simulation period. The analysis did not consider any scenarios where high biomass prices provide strong financial incentives for growers to withdraw from the CRP, give up annual rental payments, or convert land into energy crop production.

Baseline vs. High-yield Scenarios

The baseline assumes a continuation of the U.S. Department of Agriculture 10-year forecast for the major food and forage crops and extends to 2030. The average annual corn yield increase is assumed to be slightly more than 1% over the 20-year simulation period. The baseline also assumes continued trends toward no-till and reduced cultivation and an annual increase of 1% in energy crop yields. The 1% change in annual yield reflects learning or experience in planting energy crops and limited gains from breeding and selection of better varieties. The high-yield scenario is more closely aligned to the assumptions in the 2005 *BTS*. This scenario assumes higher corn yields and a much larger fraction of crop acres in reduced and no-till cultivation. Under high yield, the projected increase in corn yield averages almost 2% annually over the 20-year simulation period. The energy crop productivity increases are modeled at three levels: 2%, 3%, and 4% annually. These gains are due not only to experience in planting energy crops but also to more aggressive implementation of breeding and selection programs.

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