Photo courtesy of Rob Mitchell, ARS

U.S. BILLION-TON UPDATE

Crop Residues and Agricultural Wastes*

Summary of Findings

The 2011 *Billion-Ton Update* estimates potential supplies of agricultural crop residues and wastes under different yield, tillage, and feedstock farmgate prices. The largest quantities of agricultural residues and wastes are from the major commodity crops. Under baseline assumptions, there are currently about 111 million and 94 million dry tons of primary crop residues profitable to collect at farmgate feedstock prices of $60 and $50 per dry ton, respectively. More than three-fourths of this residue resource is corn stover, followed by wheat straw, which accounts for about a fifth of the total. Other grains (barley, oats, sorghum) account for the remainder. Continued growth in crop yields and higher amounts of land in reduced-tillage and no-till cultivation increases the availability of primary crop residues significantly. By 2030, estimated supplies are 180 million dry tons. Under the high-yield scenario, the amount of corn stover that can be sustainably collected increases significantly due to assumed higher yields, as well as a greater fraction of land in no-till cultivation. By 2030, total primary residue is 320 million dry tons, with 85% of this quantity composed of corn stover.

In addition to the primary crop residues, there are a number of other residues and processing wastes available. However, with the exception of animal manure, these supplies are significantly less than the primary crop residues. In the aggregate, processing and other waste resources are in the range of 20 to 26 million dry tons, depending on the year and price ($40 to $60 per dry ton). Collectible animal manure

Supplies of primary crop residues ($60 or less/dry ton)

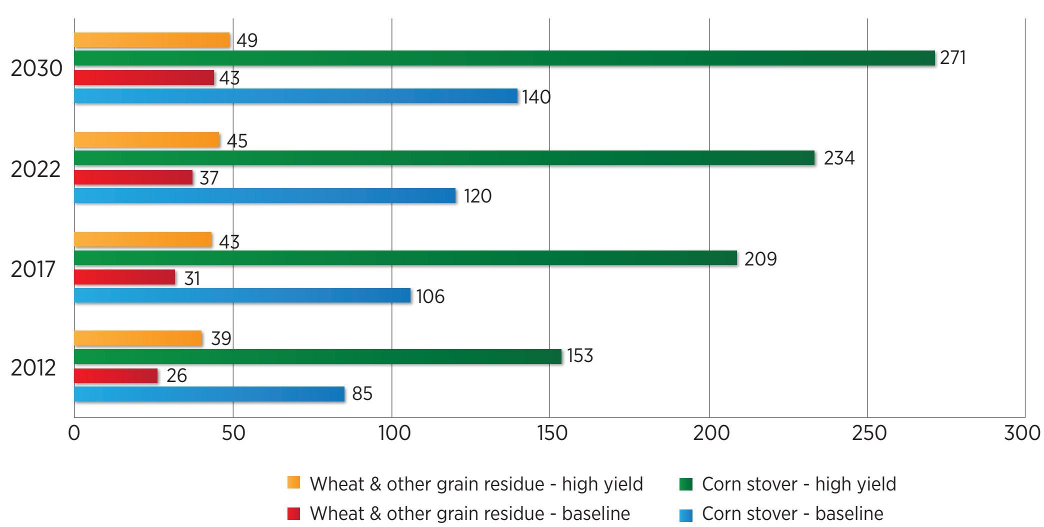

Illustration courtesy of BCS Inc.

*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.

production is larger, estimated at 30 to 60 million dry tons, at prices of $50 to $60 per dry ton.

Additional Information

The analysis of primary crop residues from the major grains—corn, wheat, sorghum, oats, and barley—used a relatively sophisticated methodology to determine how much residue must remain to keep erosion within tolerable soil loss levels and maintain soil carbon levels. A number of data sets including soils, slope, climate, cropping rotations, tillage (i.e., conventional, reduced, and no tillage), management practices, and residue collection technology were used in the analysis.

The map below summarizes results of a multiagency study led by Idaho National Laboratory to determine how much crop residue can be removed after accounting for soil carbon and erosion by crop tillage, crop rotation, yield, and collection technology. These county-level residue retention coefficients were used along with residue production costs to estimate crop residue supply. Residue production has two distinct costs—a grower payment and a cost for collecting the residue (e.g., shredding, baling, and moving bales to the field edge). The grower payment compensates for removed nutrients and organic matter and provides a profit to the farmer.

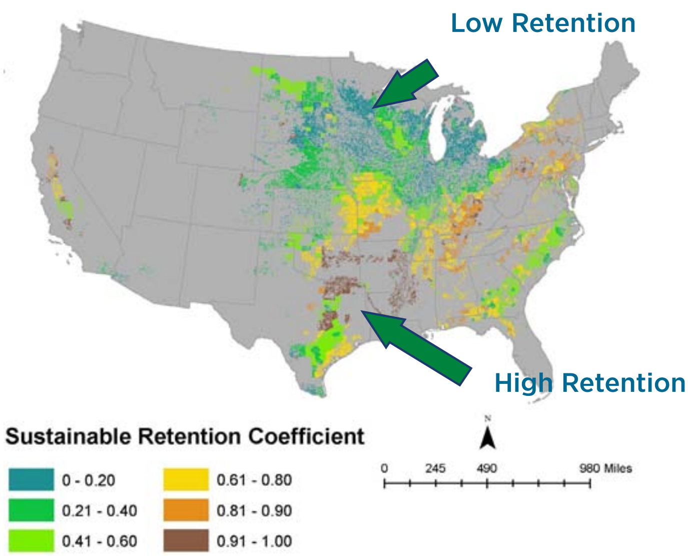

Illustration courtesy of ORNL.

Supplies of corn stover and small grain residues were estimated using POLYSYS, a policy simulation model of the U.S. agricultural sector. The model is anchored to the U.S. Department of Agriculture (USDA) 10-year projection and includes national demand, county supply, livestock, and income modules. The model estimates potential crop residue supplies from corn, wheat, grain sorghum, oats, and barley by accounting for how much residue is produced (a function of crop yield, moisture, and residue-to-grain ratio), residue production costs (a fixed per-ton grower payment plus collection costs per ton of residue removed), and how much residue must remain to keep erosion within tolerable soil loss levels while maintaining soil carbon levels. For cotton and rice—two of the three other major crops in POLYSYS—residues are estimated separately. For soybeans, it is assumed there is no residue available.

The amount of agricultural residue that can potentially be removed from agricultural cropland is subject to two modeled constraints. First, removals cannot exceed the tolerable soil loss limit as recommended by the USDA's Natural Resource Conservation Service (NRCS). Second, removals cannot result in long-term loss of soil organic matter as estimated by the Revised Universal Soil Loss Equation and the Wind Erosion Prediction System. Both of these programs incorporate a soil quality index and are employed by NRCS to help guide farmers, ranchers, and landowners in making their conservation plans.

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.

U.S. DEPARTMENT OF ENERGY
Energy Efficiency & Renewable Energy

Oak Ridge National Laboratory

DOE/EE-0587 • August 2011

Printed with a renewable-source ink on paper containing at least 50% wastepaper, including 10% post consumer waste.