The Billion-Ton Update Report: Approach and Assumptions

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Biomass 2011

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Biomass Feedstock Resource Base

- **Forestland resources: 504 million acres of timberland, 91 million acres of other forestland**
- **Agricultural resources: 342 million acres cropland, 39 million acres idle cropland, 68 million acres cropland pasture**

- **Forest resources**
  - **Logging residues**
  - **Forest thinnings (fuel treatments)**
  - **Conventional wood**
  - ***Fuelwood***
  - **Primary mill residues**
  - **Secondary mill residues**
  - ***Pulping liquors***
  - **Urban wood residues**

- **Agricultural resources**
  - **Crop residues**
  - ***Grains to biofuels***
  - **Perennial grasses**
  - **Perennial woody crops**
  - **Animal manures**
  - **Food/feed processing residues**
  - **Annual energy crop**

Goals of the 2011 Draft Update

- **To address biomass resource availability, sustainability, and costs**
- **To improve the data, the methodology, and projections of 2005 Report**
- **To address concerns and issues from the 2005 study**

Updates included in 2011 Report

- Draft report reviewed by:
  - 3 USDA
  - 4 university
  - 2 national institute/council
  - 2 international

2005 BTS	2011 Update
National estimates – no spatial information	County-level with aggregation to state, regional and national levels
No cost analyses – just quantities	Supply curves by feedstock by county – farmgate/forest landing
Crop residue removal sustainability addressed from national perspective; erosion only	Crop residue removal sustainability modeled at soil – scale; erosion & soil C
No explicit land use change modeling	Land use change modeled for energy crops
Long-term, inexact time horizon (2005; ~2025 & 2040)	2010 – 2030 timeline (annual)
2005 USDA agricultural baseline and 2000 forestry RPA/TPO	2010 USDA agricultural baseline 2010 FIA inventory and 2007 forestry RPA/TPO
Erosion constraints to forest residue collection	Greater erosion plus wetness constraints to forest residue collection

Resource Estimation Approach

- County feedstock supply curves for major primary cropland and forestland resources
  - Agricultural policy model (POLYSYS) used to estimate supply curves and land use change for crop residues and energy crops
    - USDA baseline forecast and projections and NASS data (yields, acres, crop prices, production, exports, etc.) to 2030
    - Requirements for resource sustainability – crop residue retention coefficients, tillages, rotations
    - Energy crop productivity
  - Resource cost analysis used to estimate supply curves (cost-quantities) for forestland resources
    - USDA/FS data (FIA, TPO, RPA)
    - Forest residue access, recovery, and merchantability
    - Requirements for resource sustainability

Scenarios Analyzed

Baseline scenario

- USDA Baseline forecast for crop yields, acres, etc., extended to 2030
- National corn yield of 160 bu/ac in 2010, increases to 201 bu/ac in 2030
- Assumes a mix of conventional till, reduced till, and no-till
- Stover to grain ratio of 1:1
- No residue collected from conventionally tilled acres
- Energy crop yields increase at 1% annually attributable to experience in planting energy crops and limited R&D

High-yield scenario(s)

Same as Baseline Scenario except for the following:

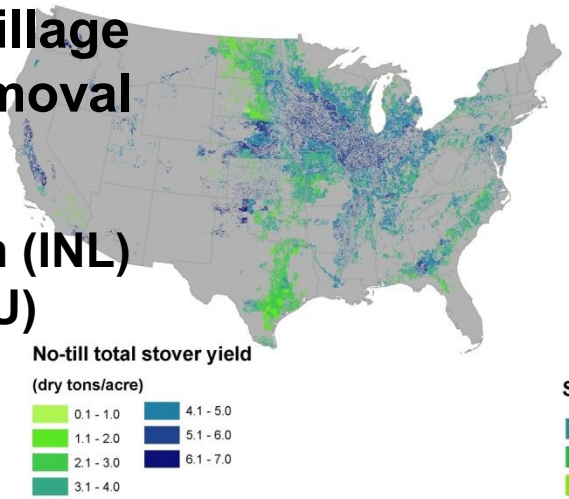
- Corn yields increase to a national average of 265 bu/acre in 2030
- Higher amounts of cropland in no-till to allow greater residue removal
- Energy crop yields increase at 2%, 3%, and 4% annually (attributable to more aggressive R&D)

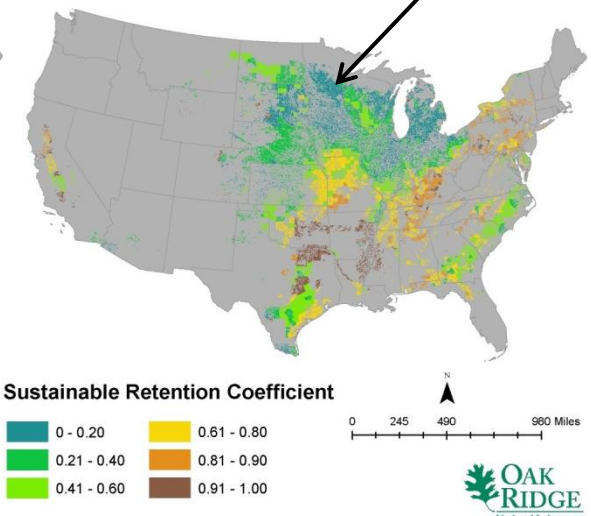
Agricultural Crop Residue Collection Assumptions

- **Yields and acres planted and harvested (baseline forecast)**
- **Stover to grain ratio**
- **Tillage (conventional, reduced, no-till) and rotations**
- **Sustainability - residue retention coefficients estimated for erosion and soil carbon with separate coefficients for reduced tillage and no-till; no residue removal under conventional till**
  - **Developed by Dave Muth (INL) and Richard Nelson (KSU)**
- **Collection efficiency**

Crop Management Zones

High residue availability





Energy Crop Production Assumptions

- Allowed on cropland, cropland pasture, and some permanent pasture
- Cultural practices based on minimal tillage and recommended fertilizer and herbicide applications
- Used BMPs for establishment, cultivation, and harvesting
- Intensification of pasture land required to meet lost forage
- Retained low-levels of biomass for long-term site productivity with nutrient replacement
- Generally assumed landscape diversity of energy crops with other agricultural and forestry activities
- All energy crops are unirrigated
- Annual energy crops (i.e., energy sorghum) limited to non-erosive cropland and part of multi-crop rotation

Forest Resource Collection Assumptions

- **Evaluated biomass removal sustainability (erosion, soil nutrients, biodiversity, soil-organic carbon, and long-term soil productivity)**
  - **Site specific retention is based on steepness and wetness**
- **Accounted for changes in FIA database since 2009**
- **Re-estimated supply curves for integrated operations for logging residues and fuel treatment thinnings on timberland**
- **Estimated supply curves for conventionally sourced wood (i.e., pulpwood) from additional harvests and shift from current uses to bioenergy**
- **Sources include logging residues, fuel treatment thinnings, primary and secondary mill residues, and urban wood wastes (MSW and C&D debris)**

Energy Crop Yield Growth Assumptions

Including Woody and Herbaceous Energy Crops

	2012	2017	2022	2030	2017	2022	2030
Crop	**Yield**	**Baseline 1% annual growth**			**High-yield 2%–4% annual growth**		
		Dry tons/acre/year			Dry tons/acre/year		
Low end of yield range	2	2.1	2.2	2.4	2.2 – 2.4	2.4 – 3.0	2.9 – 4.1
	3	3.2	3.3	3.6	3.3 – 3.6	3.7 – 4.4	4.3 – 6.1
	4	4.2	4.4	4.8	4.4 – 4.9	4.9 – 5.9	5.7 – 8.1
	5	5.3	5.5	6.0	5.5 – 6.1	6.1 – 7.4	7.1 – 10.1
	6	6.3	6.6	7.2	6.6 – 7.3	7.3 – 8.9	8.6 – 12.2
Middle of yield range	7	7.4	7.7	8.4	7.7 – 8.5	8.5 – 10.4	10.0 – 14.2
	8	8.4	8.8	9.6	8.8 – 9.7	9.8 – 11.8	11.4 – 16.2
High end of yield range	9	9.5	9.9	10.8	9.9 – 10.9	11.0 – 13.3	12.9 – 18.2
	10	10.5	11.0	12.0	11.0 – 12.2	12.2 – 14.8	14.3 – 20.3
	11	11.6	12.2	13.2	12.1 – 13.4	13.4 – 16.3	15.7 – 22.3
	12	12.6	13.3	14.4	13.2 – 14.6	14.6 – 17.8	17.1– 24.3

Notes: The yields shown for 2017–2030 for the baseline and high-yield scenarios reflect the standing yield of the energy crop before losses. It is the yield for the energy crop planted in that particular year. For example, if the 2009–2012 yield for a particular crop is 5 dry tons per acre, the yield for that crop would be 5.5 dry tons per acre if planted in 2022 under the baseline and 6.1 to 7.4 dry tons per acre under the high-yield scenario.

Bioenergy KDF

- All resources identified as potentially available in the Billion-Ton Update will be published online
  - http://www.bioenergykdf.net
- Detailed modeling input datasets will be published at a later date (specifically, energy crop costs)

Thank you!

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