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

# Billion Ton Study - A Historical Perspective

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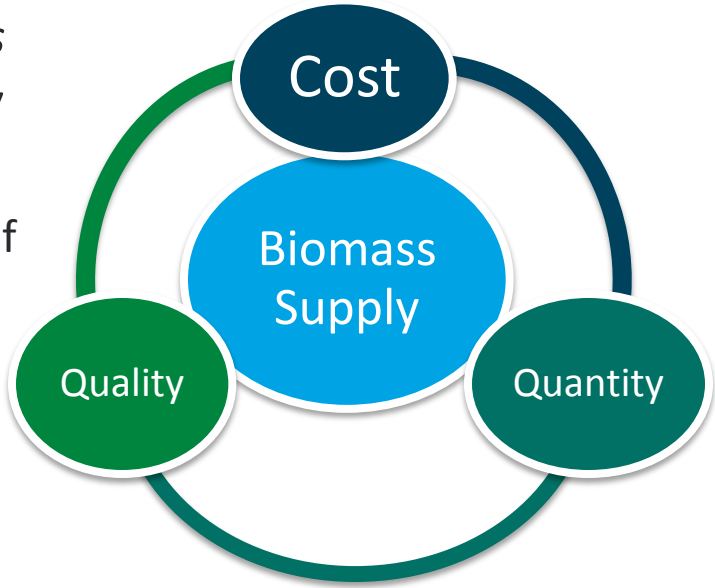
# Motivation and Goals

*In order to realize a commercial advanced biofuels industry, we need a **significant sustainable supply of biomass***

- DOE is focused on analyzing the resource potential of biomass to understand feedstocks supply for the **bioeconomy** of the future
- Identify the **what, where, when, how** of commercial feedstocks from agriculture and forestry systems for fuels, power, and products
- Provide timely and credible estimates of feedstock supplies and prices to support policy, research, and commercialization
- Supply analysis is housed in the **BETO Feedstock Supply and Logistics R&D Platform**



# History and Accomplishments

<u>Billion-Ton Study (BTS), 2005</u>

- Technical assessment of agricultural and forestry systems to supply low-valued biomass for new markets
- Identified adequate supply to displace 30% of petroleum consumption; i.e. physical availability

<u>Billion-Ton Update (BT2), 2011</u>

- Quantified potential economic availability of feedstocks for 20-year projection
- Publicly released county-level supply curves for 23 candidate feedstocks through Bioenergy Knowledge Discovery Framework.

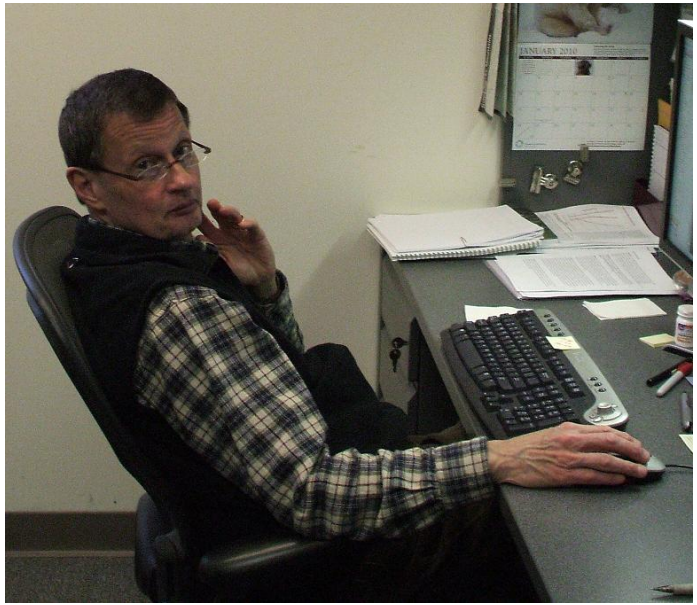
# Major Differences: 2005 BTS Study, 2011 Billion-Ton Update, 2016 Report

| | 2005 BTS | 2011 Update |
|---|---|---|
| **Spatial Scale** | National estimates – no spatial information | County-level with aggregation to state, regional and national levels. |
| **Supply and Cost Analysis** | No cost analyses – just quantities | Roadside supply curves by feedstock by county |
| **Land Use Modeling** | No explicit land use change modeling, cropland conversion only | Land use change allows energy crops established on cultivated cropland and pastureland |
| **Timeframe** | Long-term, mid-century time horizon (2005; 2025 & 2040-50) | 2012 – 2030 timeline (annual) |
| **Major Data Sources** | 2005 USDA agricultural projections; 2000 forestry RPA/TPO | 2010 USDA agricultural projections: 2010 FIA inventory and 2007 forestry RPA/TPO |
| **Potential Biomass Feedstocks** | Broad categories of residues/wastes and dedicated energy crop systems | 20 county-level biomass feedstocks |
| **Agricultural Supply Sustainability** | Crop residue removal sustainability addressed from national perspective; erosion only | Crop residue removal sustainability modeled at soil level (wind & water erosion, soil C) |
| **Forestry Supply Sustainability** | Erosion constraints to forest residue collection | Greater erosion plus wetness constraints to forest residue collection |

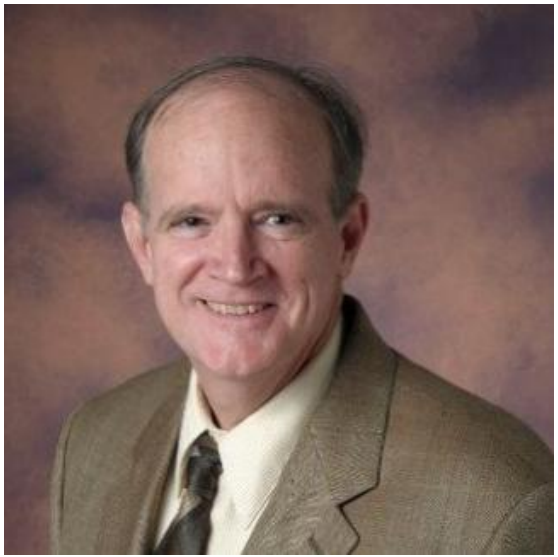
# Billion Ton Study - A Historical Perspective

***The People***

# Couple of Champions… to name a few



Bob Perlack, ORNL,
Research Economist



John Ferrell, BETO, Program Manager

# Contributors to the 2005 Billion Ton Study

- Oak Ridge National Laboratory
  - Robert D. Perlack
  - Lynn L. Wright
  - Anthony F. Turhollow
  - Robin L. Graham
- U.S. Forest Service
  - Bryce J. Stokes
- USDA Agricultural Research Service
  - Donald C. Erbach

# Contributors to the 2011 Billion-Ton Update

- Oak Ridge National Laboratory - 10
- Idaho National Laboratory – 3
- University of Tennessee - 5
- Navarro Research & Engineering - 1
- USDA/Forest Service - 13
- USDA/ARS - 7
- USDA/NRCS – 1
- USDA/NIFA - 1
- Iowa State University – 1
- Kansas State University - 1
- State University of New York – 3
- Texas A&M – 1
- University of Illinois - 1
- University of Minnesota - 2

**Summary:**
- 50 contributors
- 2 Labs
- 4 USDA agencies
- 37 Ph.D.s
- 7 Universities

# Contributors to the 2011 Update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Thomas B. Voigt


* Co-leads

# Billion Ton Study - A Historical Perspective

***Interesting Facts***

# Examples of Earlier Work

- Walsh, Marie E., Robert L. Perlack, Anthony Turhollow, Daniel de la Torre Ugarte, Denny A. Becker, Robin L. Graham, Stephen E. Slinsky, and Daryll E. Ray. Biomass Feedstock Availability in the United States: 1999 State Level Analysis. *Unpublished ORNL Report*. April 30, 1999. Updated January 2000.
- Walsh, Marie E., Daniel G. de la Torre Ugarte, Hosein Shapouri, and Stephen P. Slinsky, Bioenergy Crop Production in the United States--Potential Quantities, Land Use Changes, and Economic Impacts on the Agricultural Sector, *Environmental and Resource Economics*, vol. 24, pp. 313-333, 2003.

# Biomass R&D Act & Forerunner Executive Order

- With Executive Order 13134 issued in August 1999, President Clinton launched a national Bioenergy Initiative, "a national partnership...to **produce power, fuels and chemicals** from crops, trees and wastes." The Executive Order established a goal: to "triple the U.S. use of biobased products and bioenergy by 2010.“
- The Biomass Research and Development Act of 2000, later amended by Section 9001 of the Food Conservation and Energy Act of 2008 (FCEA) and most recently reauthorized in the Agricultural Act of 2014.

# “Billion Tons” Vernacular Origin (circa 2001)

“The carbohydrate economy may be on the verge of a full scale revival. The potential is huge. **In the continental U.S. alone we could grow and harvest, on a sustainable basis more than 1 billion tons of additional plant matter.** That would be sufficient to completely replace petrochemicals with biochemicals or put a serious dent in our consumption of fossil fuels for transportation or modestly contribute to the nation's supply of electricity, in the process creating thousands of new manufacturing and processing facilities in rural areas.”

**BIOMASS RESEARCH AND DEVELOPMENT TECHNICAL ADVISORY COMMITTEE RECOMMENDATIONS, December 2001.**
**http://www.biomassboard.gov/pdfs/advisorycommitteerdrecommendations2001.pdf**

# Origins of the Study

- Nov 14, 2002 - met with _____ to discuss forest supply curves
- Jan 15, 2003 - participated on a conference call with _____ of NREL
- Apr 28, 2003 - biomass meeting on ag residues
- Sep 30, 2003 - first mention of "biomass vision" and forest residue supply curves
- Nov 7, 2003 - biomass vision paper to be a top priority

“Meeting Notes from Undisclosed Participant”

# “Addicted to Oil” Speech

“And here we have a serious problem: America is addicted to oil…”

In his **2006** State of the Union Address, President Bush announced the Advanced Energy Initiative and proposed a 22 percent increase in funding for clean energy technology research at the Department of Energy. … We will change how we power our homes and offices… We will also change how we power our cars by improving batteries for hybrid and plug-in hybrid vehicles, making cellulosic ethanol cost-competitive with corn-based ethanol by 2012, and by accelerating the development of zero-emission cars that run on hydrogen.

http://georgewbush-whitehouse.archives.gov/ceq/advanced-energy.html

# BTS in Policy

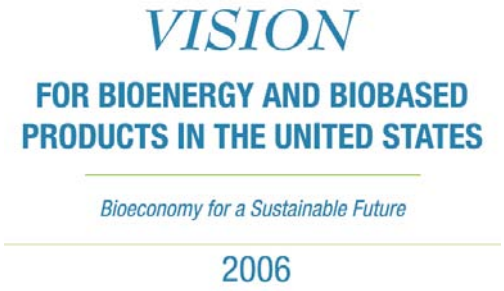
Virtually all domestically produced ethanol currently comes from corn. However, corn and other starches and sugars are only a small fraction of biomass that can be used to make ethanol. A recent **DOE/USDA study** suggests that, with aggressive technology developments, biofuels could supply some 60 billion gallons per year – 30% of current U.S. gasoline consumption – in an environmentally responsible manner without affecting future food production.

**Advanced Energy Initiative, White House, 2006**

**http://georgewbush-whitehouse.archives.gov/stateoftheunion/2006/energy/#section3**

# Vision Continued

DOE has established an objective to achieve cost-competitive production of cellulosic ethanol by 2012 per the President's Advanced Energy Initiative and to displace 30 percent of 2004 levels of gasoline consumption with biofuels by 2030. Thirty percent of the 2004 market for gasoline consumption is about 60 billion gallons of ethanol, or 40 billion gasoline-equivalent gallons.




http://www.biomassboard.gov/pdfs/final_2006_visionkw.pdf

# Billion Ton Study - a Historical Perspective

***The Closing***

# Well Known Study

- **Known Informally** - http://www.biofuelsdigest.com/bdigest/2011/08/11/son-of-billion-ton-a-10-minute-version-of-the-landmark-biomass-report/
- **Editorial in Science** - http://www.sciencemag.org/content/312/5778/1277.full.pdf
- **Workshop** - Billion Ton Study: What can be Learned about Bioenergy Sustainability? http://web.ornl.gov/sci/ees/cbes/20110929_BillionTonWorkshop.shtml
- Second Generation Biomass Feedstock: The Billion-Ton Gorilla in the Renewables Room http://polymerinnovationblog.com/second-generation-biomass-feedstock-the-billion-ton-gorilla-in-the-renewables-room/

# Maybe Too Well Known

As for the negatives, my point was to highlight the fact that the update of the study (which was **criticized widely in the industry** when it was first released) has gone a long way in clearing up the issues that were identified in the early years after the study's release. I think the DOE's methodology in the second study is much stronger this time around and therefore much closer to accurate.

http://www.forest2market.com/blog/A-Closer-Look-at-the-Billion-Ton-Study-Update

# What is the Value of the Billion Ton Study?

**In weniger als einer Minute** können Sie mit dem Lesen von *U.S. Billion-Ton Update: Biomass Supply for a Bioenergy a...* auf I
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Department of Energy (DOE) (Autor), Office of Energy Efficiency and Renewable Energy (EERE) (Autor), Office of the Biomass Program (Autor)

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***Thanks***

***and***

***Look in the Book***

http://feedstockreview.ornl.gov/pdf/billion_ton_vision.pdf

http://www1.eere.energy.gov/biomass/pdfs/billion_ton_update.pdf