Projecting GHG Emissions from Agriculture:
Effects of Shifting Trends in Cellulosic Feedstock Data

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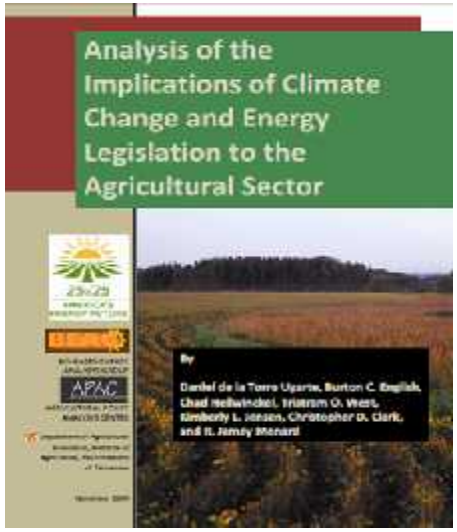
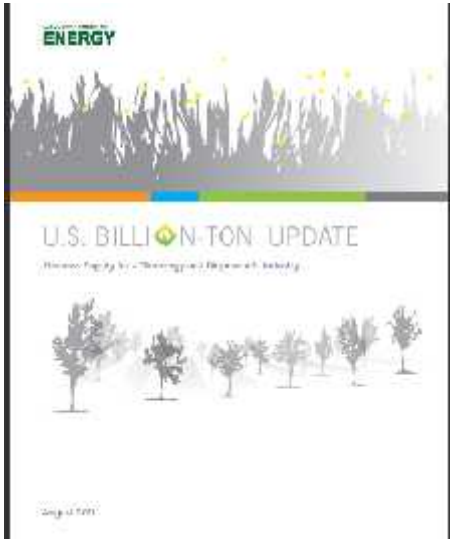


25x25 document, November 2009

EPA-USDA Workshop on
Forestry, Agriculture, and Climate Change:
Modeling to Support Policy Analyses
Shepherdstown, WV
September 26-29 2011



Billion Ton Update August 2011

Objective today

To make you aware of the implications of new feedstock data.

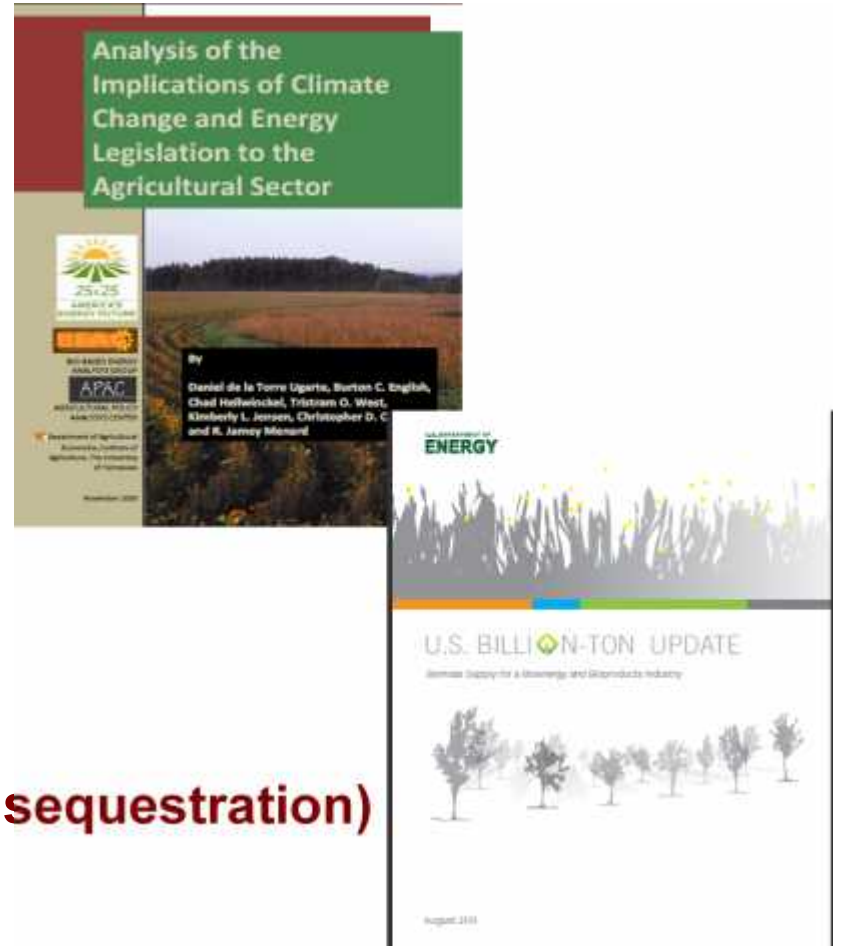
What new data?

- New costs of production
- New yields
- New environmental constraints
- Addition of standing wood harvesting

What implications?

- More crop residues harvested
- More standing trees harvested
- Less herbaceous grasses harvested

= increase in GHG emissions (or less sequestration)



Overview of Model

- POLYSYS model
  - Partial equilibrium model of US agricultural economy
  - POLYSYS iterates annually, for 20 years.
  - Linear programming model solves supply side at county level.
  - Econometric demand side.
  - 9 major crops (3 tillage types) + bioenergy crops.
  - Biomass can come in on both cropland and pasturelands.
  - Can harvest crop residues under erosion and carbon constraints.
  - Can meet a national demand level for bioelectricity or ethanol and estimate market feedstock price endogenously.

How POLYSYS Works

Accounting for carbon: Line of demarcation

Mining

Manufacture of machinery, buildings, tools, fencing

Manufacture of inputs

Fertilizers
Chemicals
Seeds
Fuel

Farm Operations

Transportation
Processing
Refrigeration
Cooking

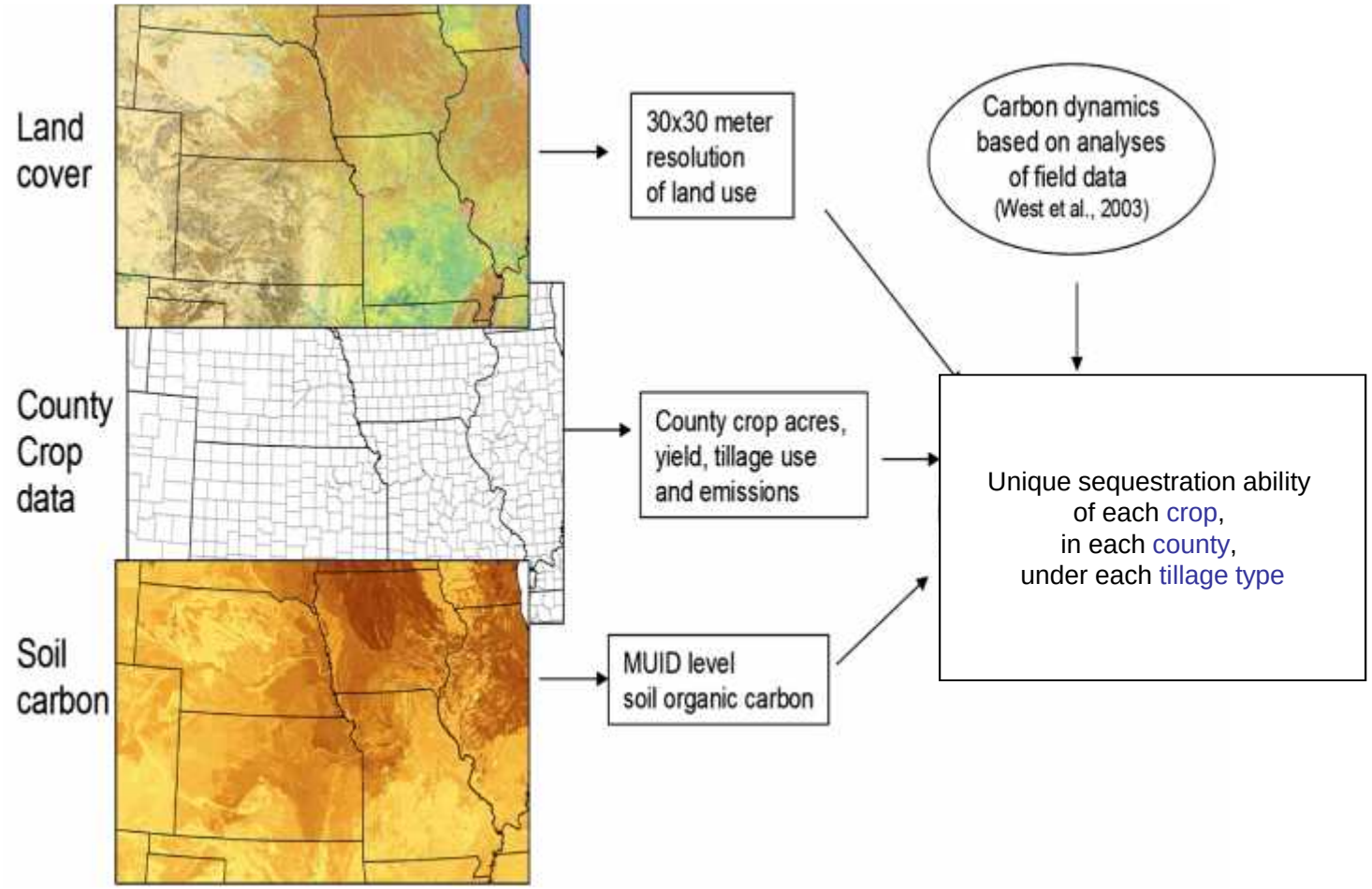
Soil changes

N_20
Lime decomposition

Respiration and decomposition
Fossil fuel displacement

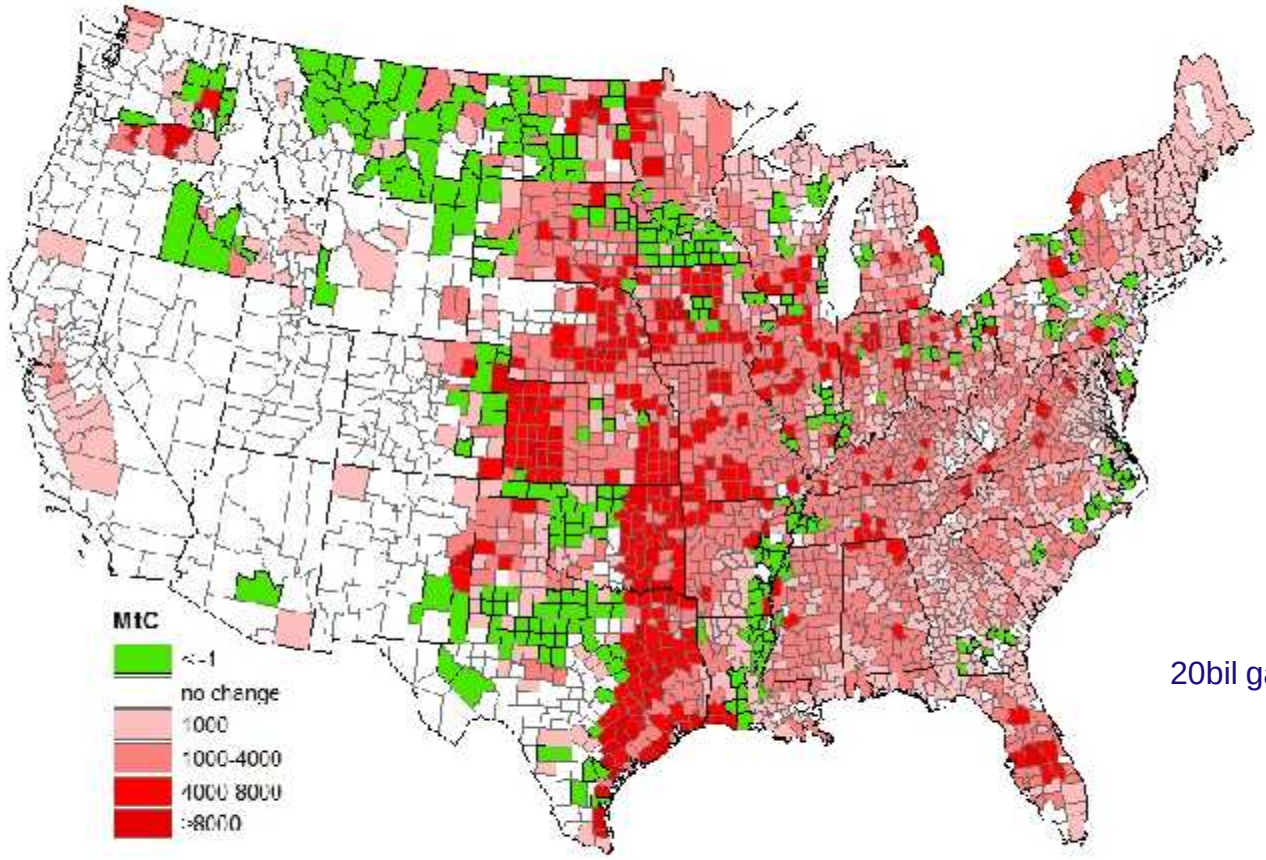
How POLYSYS Works

Accounting for soil carbon sequestration



Example of resolution:

Change in carbon emissions

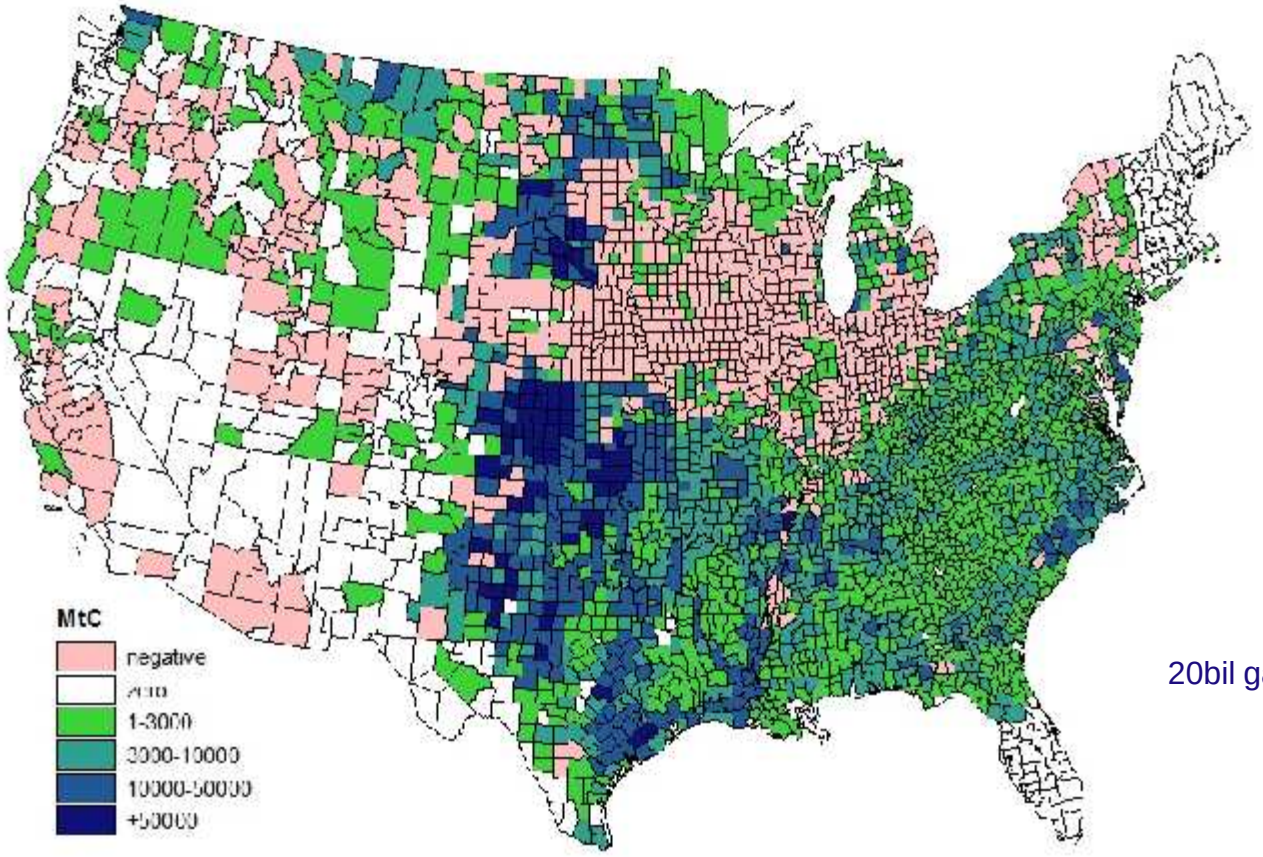


2030
20bil gal cellulosic ethanol

Comparing 'advanced fuel' policy to NO new bioenergy policy

Example of resolution:

Change in carbon sequestered

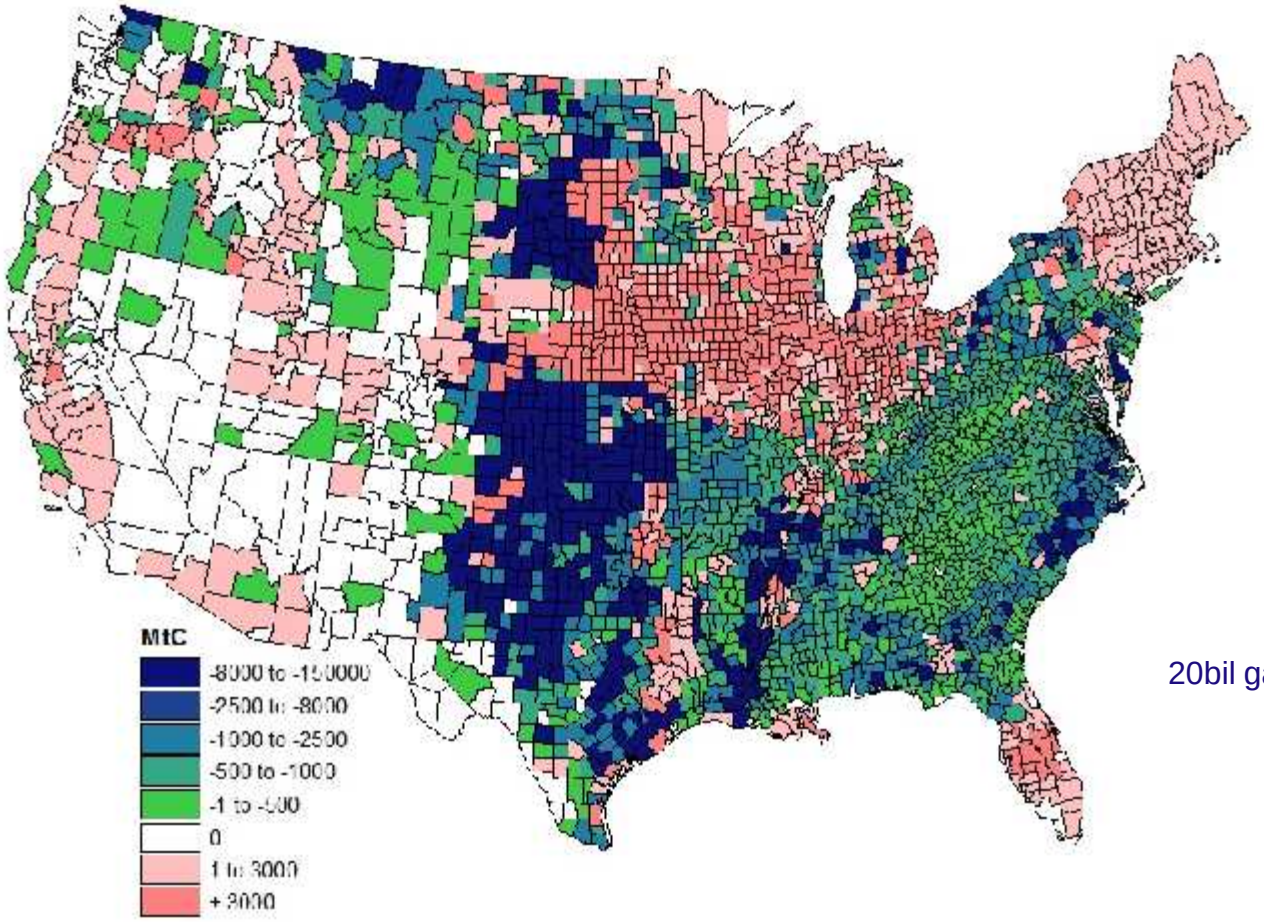


2030
20bil gal cellulosic ethanol

Comparing 'advance fuel 'policy to NO new bioenergy policy

Example of resolution:

Change in net carbon flux

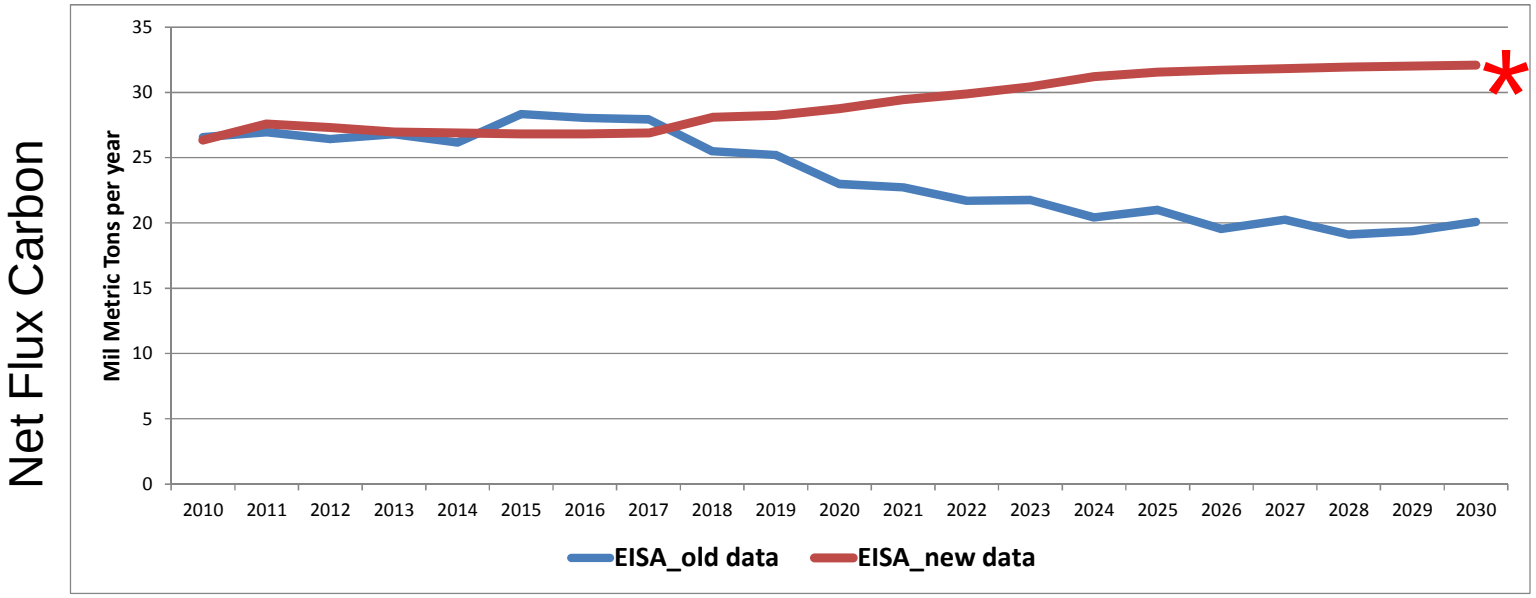


2030
20bil gal cellulosic ethanol

Comparing 'advanced fuel' policy to NO new bioenergy policy

Shifting Trends

Meeting EISA using old and new data



Shifting feedstock implications of meeting EISA		
	Old data	New data
Crop Residues (mil dt)	29.7	116.9
Herbaceous grasses (mil dt)	179.5	15.9
Woody (mil dt)	13.3	90.8
Total	222.5	223.6

Units: Million dry tons

Year: 2030

...means...

Shifting GHG implications of meeting EISA		
	Old data	New data
Emissions from inputs (MMtCeq)	49.9	40.64
Sequestration in soils (MMtC)	-29.83	-8.57
Total net flux	20.07	32.07

Units: Million metric tons carbon equivalent

Year: 2030

*!!Not accounting for GHG emissions or soil changes from forestland harvesting!!

Take home messages

- **New data indicates that standing wood harvesting and crop residue harvesting are more extensive and economical than previously thought.**
- **Previous benefits of herbaceous grasses are not realized.**
  - **Herbaceous grasses put half their growth belowground**
  - **Herbaceous grasses harvest annual accumulation (not multi-year accumulation like trees)**
- **If carbon is an important policy goal of biofuel production, additional incentives/restrictions may be necessary to increase carbon benefits.**

Policy Suggestions

Maximizing carbon benefits of bioenergy policy (applies whether filling EISA or RES)

- **Transition Assistance (BCAP)**
  - Make sure the new rules pay for establishing biomass feedstocks that sequester carbon.
- **Conservation Stewardship Program (NRCS)**
  - Increase 'green payments' to any practice that builds soil organic carbon
    - sequesters carbon, increases yields, decreases nutrient runoff, makes land more resilient to droughts and floods, enhances food security
    - herbaceous crops, no-till, continuous cover, MiG
- **Management intensive grazing**
  - Key to offsetting herbaceous crop encroachment on livestock production
    - Already farmer-led movement
    - Extension service could speed adoption by farmer-to-farmer workshops

Further Reading

- Recent Studies
  - De La Torre Ugarte, DG, BC English, CM Hellwinckel, TO West, KL Jensen, CD Clark, RJ Menand (2009) **Analysis of the Implications of Climate Change and Energy Legislation to the Agricultural Sector**, Publication of the 25x'25 Working Group, Washington DC, November.
  - Hellwinckel, CM, TO West, DG De La Torre Ugarte, R Perlack (2010) **Evaluating Possible Cap and Trade Legislation on Cellulosic Feedstock Availability.** *Global Change Biology Bioenergy* 2:278-287.
  - English et al. (November 2010) **Implications of Energy and Carbon Policies for the Agriculture and Forestry Sectors**, 25x'25 Working group, Washington DC.
  - United States Department of Energy. **U.S. Billion-ton Update: Biomass Supply and Bioproducts Industry**, Oak Ridge National Laboratory August (2011)
- Upcoming Study
  - Hellwinckel CM, Phillips JG (2011) **Landuse Carbon Implications of a Drawdown of Ethanol Production and an Increase in Well-Managed Pastures**, *Carbon Management*, October?

Thank you.

Agricultural Policy
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