Expanding the Role of Biofuels in America's Energy Portfolio: Analysis of the 25x'25 Vision

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Biofuels, Food & Feed Tradeoffs
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Outline

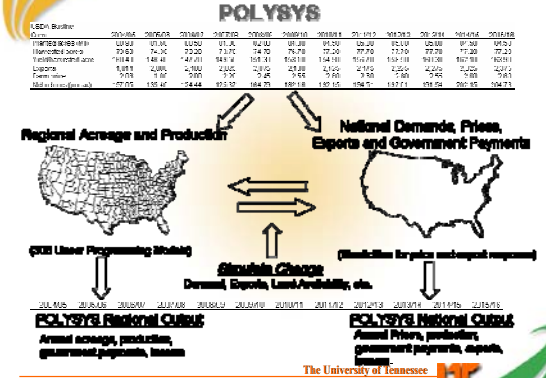
- Brief introduction to POLYSYS
- Biofuels module design
- Linkage to IMPLAN
- The analysis of the 25x'25 Vision
  - The target
  - Assumptions
  - Results

Objectives

- How far can we "push" agriculture to contribute to the 25X'25 goal?
- What are the impacts in the agricultural sector?
- What are the impacts to the economy as a whole?

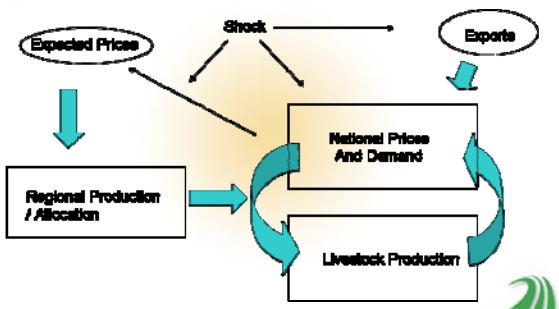
POLYSYS Sectors

POLYSYS



POLYSYS Simulation

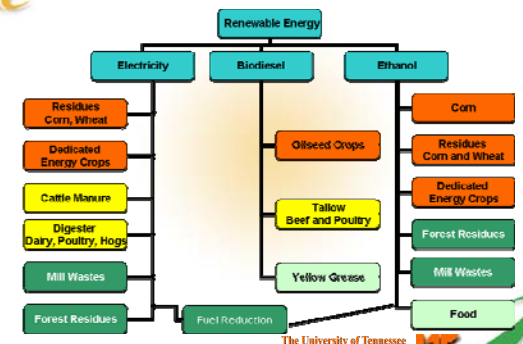
Structure and Flow (Annual)



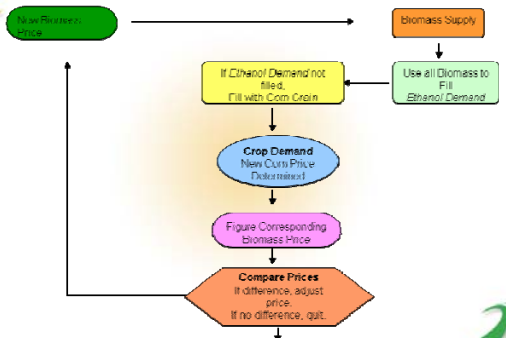
Additions for Biofuels Module

- Add Feedstocks
  - Energy Dedicated Crop – switchgrass.
  - Crop Residues – corn and wheat.
  - Wood Residues – forest thinnings, wood wastes and mill wastes.
  - Yellow grease and tallow
- Potential conversion of pasture.
- Make corn grain and biomass ethanol compete.

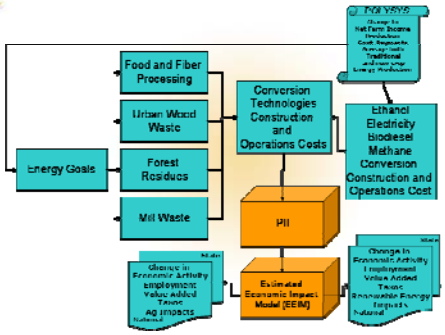
Renewable Energy Feedstocks From Agriculture in POLYSYS



Finding Optimal Feedstock Mix



Linking POLYSYS to IMPLAN



Projection of Energy Needs

Projection	Energy Demand (quads)
Department of Energy	126.99 in 2025 quads
RAND	117.7 in 2025 since replacement of coal reduces energy demand.
Current Level of Use	Roughly 101 quads in 2005

Renewables Not Modeled

Energy Source:	*2005[a] Quads*	*2025[b] Quads*
Geothermal	0.30	2.08
Solar Photovoltaic	0.00	0.69
Solar Thermal	0.01	0.00
Hydro	2.80	3.10
Wind	0.11	4.04
Total	3.22	9.91

[a] (DOE, 2006) [b] RAND analysis

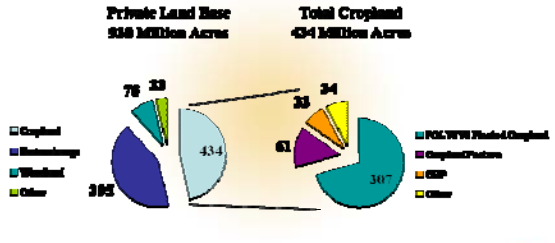
In addition, In 2005, there are 2.4 quads of biomass related energy currently used.

Renewable Energy Production
Projected 2025

Type of Energy	Units	Quantity	BTU's/unit	Quads
		Billion units		
Ethanol	Gallons	86.9	84,600	7.35
Biodiesel	Gallons	1.1	136,000	0.15
Electricity from Biomass	kWh	962	8,266	7.95
Wind	kWh	606.2	10280	6.23

[a] Also included in the analysis are the RAND projected levels for solar, hydro, and geothermal.

Land Use by Major Category
2002



Source: USDA, National Agricultural Statistical Service, 2004.

Assumptions for a Potential Outlook

- **Yield by 2025:**
  - Crops: corn (195 bu/ac), soybeans (51 bu/ac), wheat (53.00 bu/ac), energy crop (6 to12 dt/acre).
- **Management Practices:**
  - Increase crop residues by shifting corn and wheat acreage to 50% no-till, 30% reduced till and 20% conventional till by 2025.

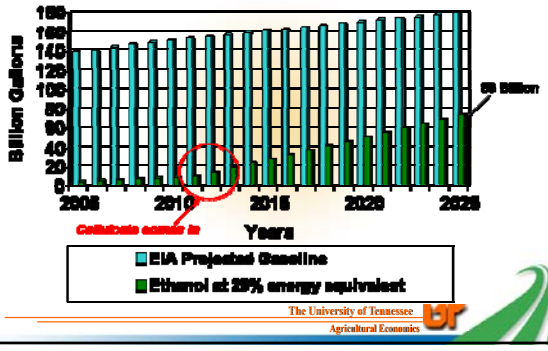
Rate of Growth Increase in Yields Beyond 2015

	USDAext	AE
Corn (bushels)	1.13%	1.69%
Sorghum (bushels)	0.76%	1.13%
Oats (bushels)	0.61%	0.91%
Barley (bushels)	0.88%	1.31%
Wheat (bushels)	0.88%	1.32%
Soybeans (bushels)	0.93%	1.39%
Cotton (pounds)	0.43%	0.64%
Rice (pounds)	0.79%	1.19%

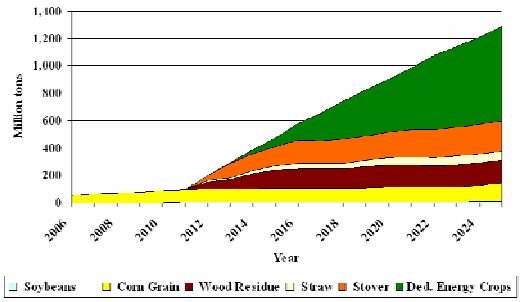
Assumptions for a Potential Outlook

- **Commodity Programs:**
  - Remain as specified in 2006.
- **Conversion Efficiency:**
  - Improved cellulosic ethanol to 89 gallons/ton by 2025 and corn ethanol conversion to 3 gallons/bushel (97 gallons/ton) by 2015. Other means to produce ethanol from food wastes remained at the current conversion rate.

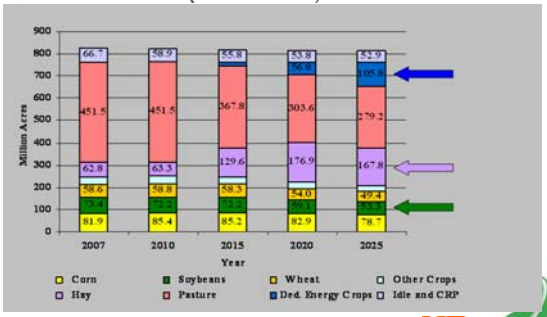
Ethanol Expansion Assumption



Feedstock for Energy: Converted to Energy



Land Use Changes:
2007, 2010, 2015, 2020, and 2025 (million acres)



Estimated Change in Prices

	$/bu from baseline			
Crop	2010	2015	2020	2025
Corn	0.16	0.02	0.16	0.71
Wheat	-0.12	-0.23	0.33	0.48
Soybeans	0.09	0.16	1.69	2.04
	$/dry ton			
Dedicated Energy Crops	0	46.85	60.9	81.85
	$/gallon			
Cost of Ethanol	1.57	1.38	1.44	1.60

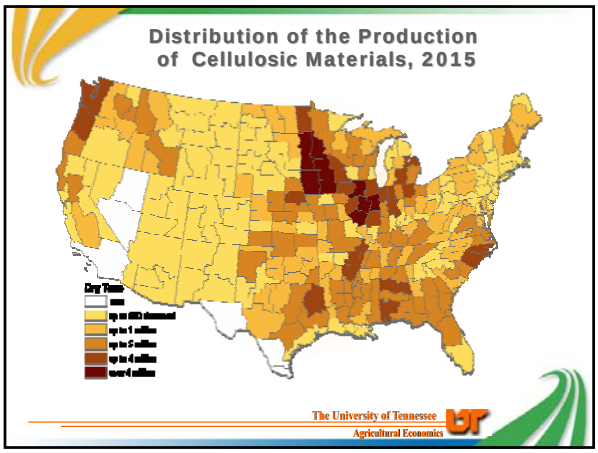
Impacts on Livestock Industry

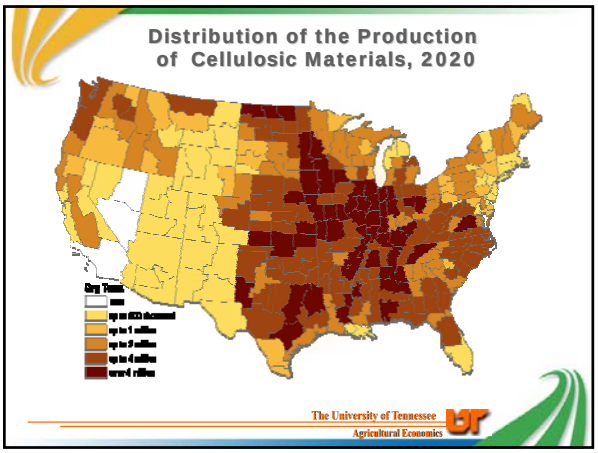
- Various components of the livestock industry react differently.
- The cattle sector is forecast to experience an increase in net returns.
- The hog and poultry industries are forecast to experience decreases in net returns, however the model is not fully capable of capturing the high degree of vertical integration in these industries making market adjustment predictions difficult.

Livestock Net Returns

Livestock Sector	% Change from baseline				
	2008	2010	2015	2020	2025
Cattle	-1.0	0.4	-0.8	2.9	3.9
Hogs	-3.6	-4.4	-7.1	-10.9	-11.0
Poultry	-2.1	-2.7	-2.7	-6.8	-6.6

Distribution of the Production of Cellulosic Materials, 2010


Distribution of the Production
of Cellulosic Materials, 2015
The University of Tennessee
Agricultural Economics


Distribution of the Production
of Cellulosic Materials, 2020
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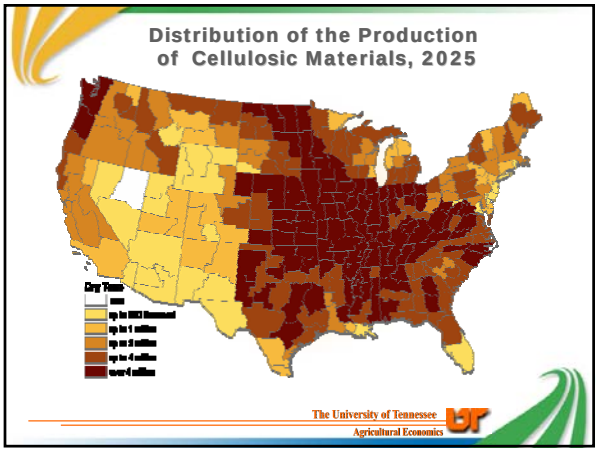
Distribution of the Production
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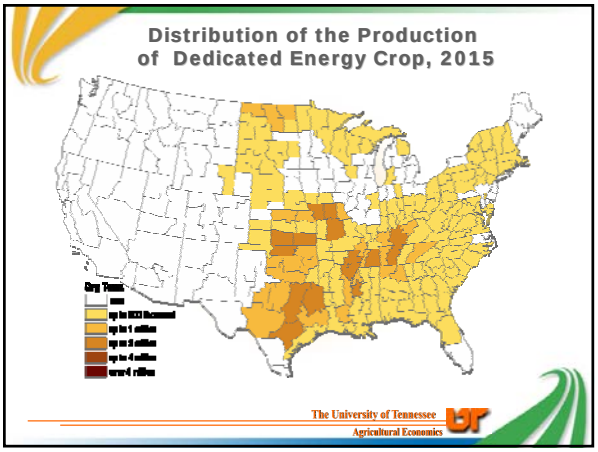
Distribution of the Production
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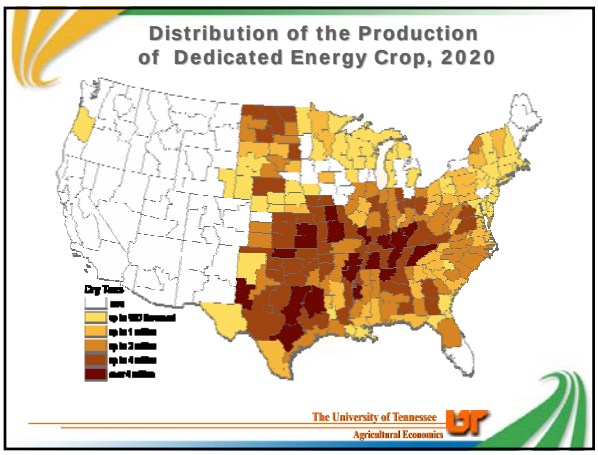
Distribution of the Production
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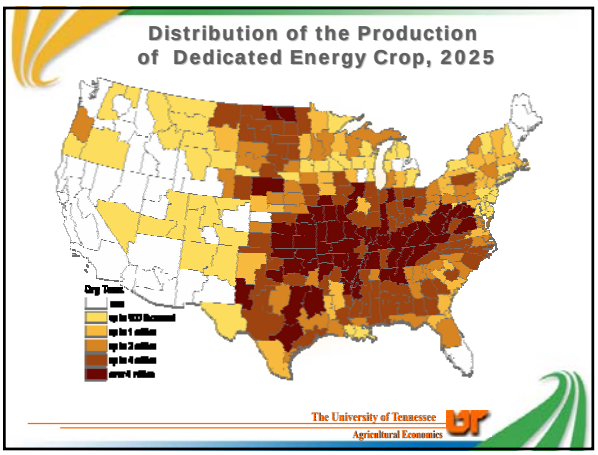
Distribution of the Production
of Dedicated Energy Crop, 2025
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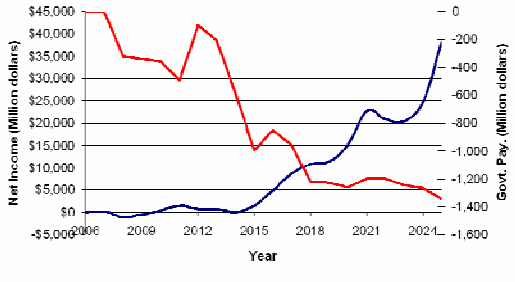
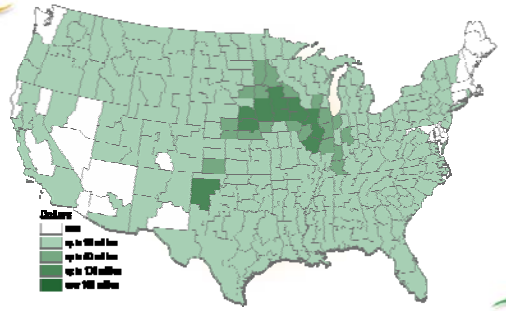
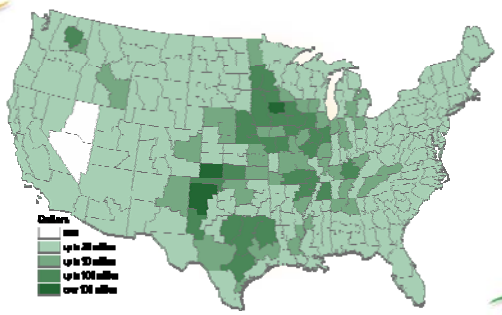
Changes in Farm Income and Government Payments (million $)



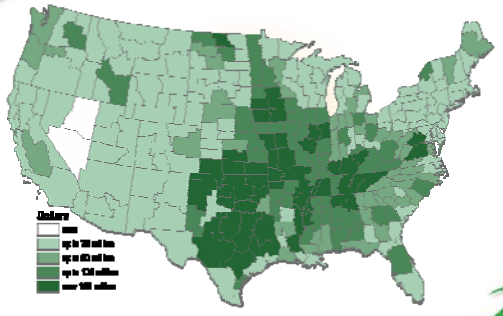
Change in Net Returns -- 2010



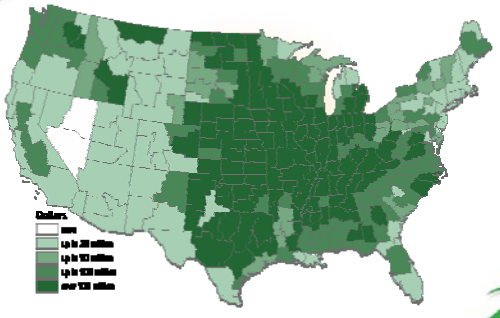
Change in Net Returns -- 2015



Change in Net Returns -- 2020



Change in Net Returns -- 2025



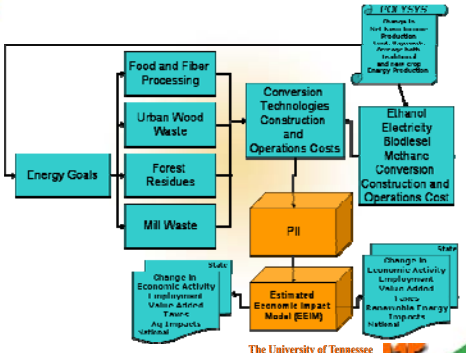
Sensitivity on availability of cellulose-to-ethanol path

Crop	Available in 2012	Available in 2015
	Crop prices in 2015	
Corn	1 %	103%
Wheat	-6 %	31 %
Soybeans	2.5 %	45 %
	$/dry ton	
Dedicated Energy Crops	46.85	115.00

Sensitivity to other key assumptions

- Crop yields
- Conversion yields
- Conversion path contribution to animal feed
- Conversion of pastureland
- World supply response

Linking POLYSYS to IMPLAN



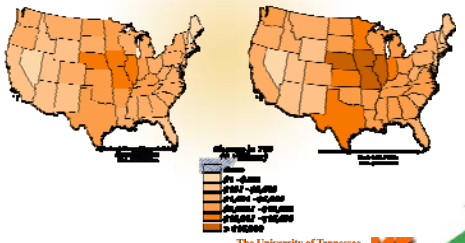
Estimated Annual National Impacts

	Change in Industry Output		Impact in Employment	
	Direct Impact	Total Impact	Direct Impact	Total Impact
	million		number of jobs	
2020:				
Agricultural Production Sector	$56,844.9	$86,012.0	536,493.1	828,569.8
Renewable Energy Sector	$93,007.9	$189,137.0	61,892.1	980,656.6
Interstate Commerce	$0.0	$173,503.0	0.0	1,340,315.5
Total	$149,852.8	$448,652.0	598,385.3	3,149,541.9
2025:				
Agricultural Production Sector	$113,664.2	$170,512.2	1,171,760.4	1,749,625.0
Renewable Energy Sector	$138,776.0	$280,854.1	93,390.3	1,460,017.7
Interstate Commerce	$0.0	$252,990.5	0.0	1,955,891.1
Total	$252,440.2	$704,356.8	1,265,150.7	5,165,533.8

Estimated Annual Midwest Regional Impacts

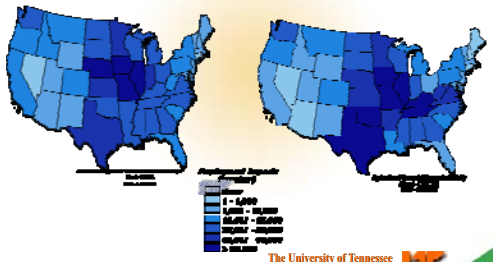
Change in TIO

Agricultural Sector | Renewable Energy Sector



Estimated Annual Midwest Regional Impacts Increased Jobs, 2025

Agricultural Sector | Renewable Energy Sector



The Challenges

- Cellulose to Ethanol path available by 2012
- Disseminate information for farmers to gear them up to plant 100 millions acres in dedicated energy crops.
- Input availability for energy dedicated crops: seed, chemical labeling, machinery.
- Yield gains
- Logistics for supplying bio-refineries: pre-treatment, transportation, storage.
- Building about 500 -1000 new plants
- Distribution of ethanol
- Ethanol sales infrastructure: E85

Conclusions

- There is sufficient potential from America's agricultural and forest lands to produce energy without impacting food security
- Currently, we have substantial capacity for production from underutilized lands

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Conclusions (Continued)

- Investments have to be ahead of the curve:
  - Agronomic research
  - Pre-treatment and conversion
  - Infrastructure of distribution and sales
- Government policy consistent with objectives and speed of adoption
- Address environmental and social concerns

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Project analysis team includes Chad Hellwinckel, Jamey Menard, Roland Roberts, Marie Walsh, and Brad Wilson in addition to Burton English, Daniel G. de la Torre Ugarte, and Kim Jensen

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http://agpolicy.org/

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