

The University of Georgia



Center for Agribusiness and Economic Development
College of Agricultural and Environmental Sciences

“Bio-Mass to Bio-energy – Lessons Learned From Georgia”

Bio-Energy Wood Supply Chain Conference
Myrtle Beach, SC, April 14, 2008

www.caed.uga.edu

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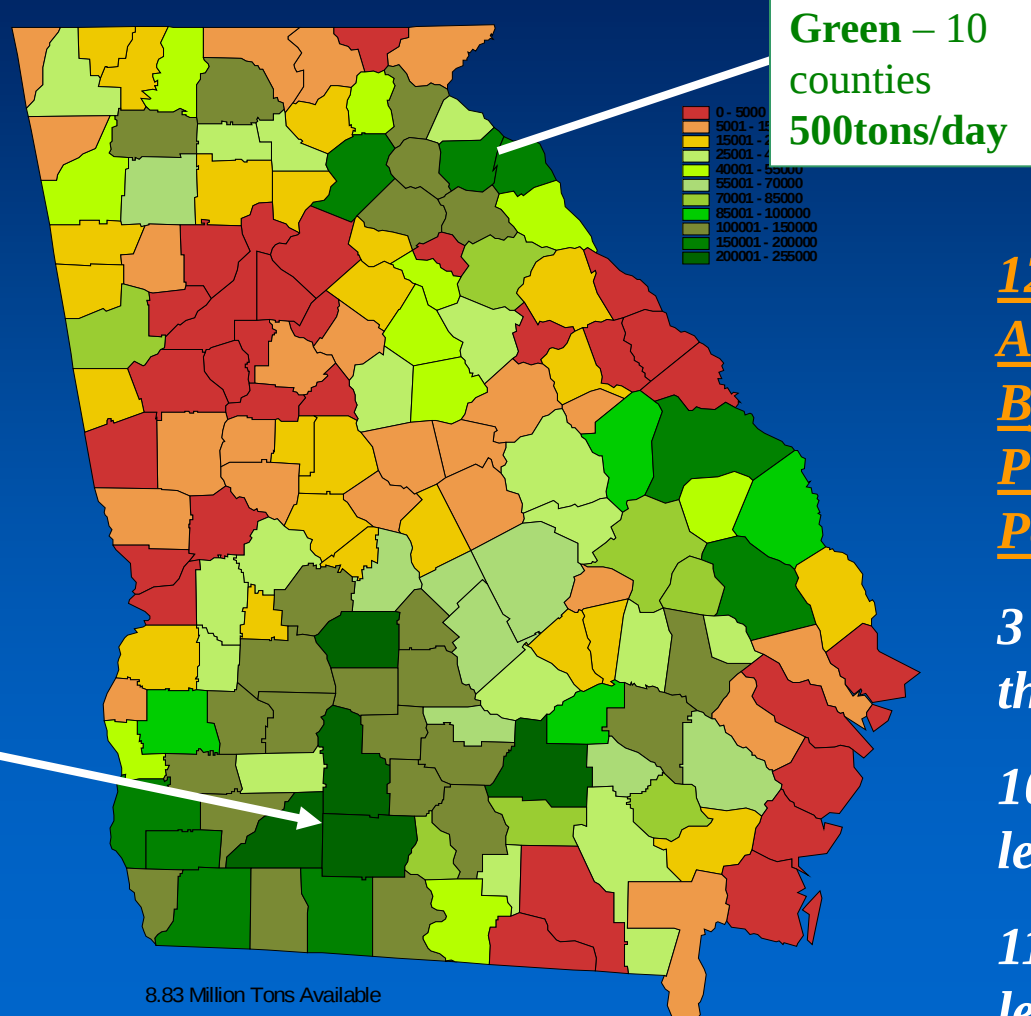
Biomass Conversion

Implications for Feedstock Availability and Returns

- **Convert Biomass into Ethanol called “Cellulosic Ethanol”**
 - Not yet proven on industrial scale
 - Very energy dependent
- **Convert Biomass into electricity**
 - Gasification
 - Pyrolysis

Status -Total Agricultural By Product Biomass Produced 2006 - 8.83 MT, Wood Harvest Residue 5.05 MT, TOTAL 14 MT

Estimated Biomass Available from Agricultural Sources (Tons)



12 Primary
Ag/Forestry
By-Products –
Peanut Hulls to
Poultry Litter

*3 BTU cost less
than coal*

*10 BTU cost
less than NG*

*11 BTU cost
less than Petro.*

Biomass Sources &

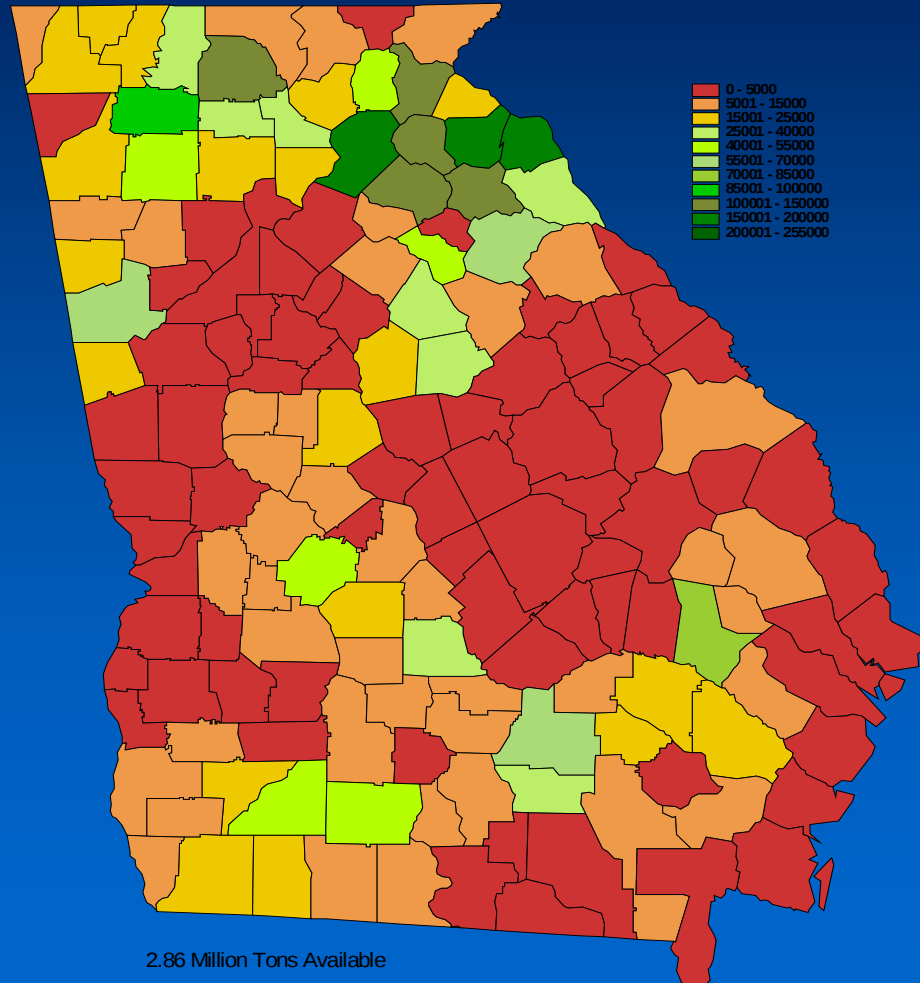
Costs – 2006 WT

• Pecan Hulls	\$17.78
• Poultry Litter	\$24.46
• Gin Trash	\$19.94
• Wood Chips	\$27.28
• Bark	\$24.62
• Wood Residue	\$26.46
• Peanut Hulls	\$44.63
• Cotton Stalks	\$50.96
• Hay	\$61.25
• Switch Grass	\$91.25

Total Agricultural By-Product Biomass Produced Less Than \$25/ton

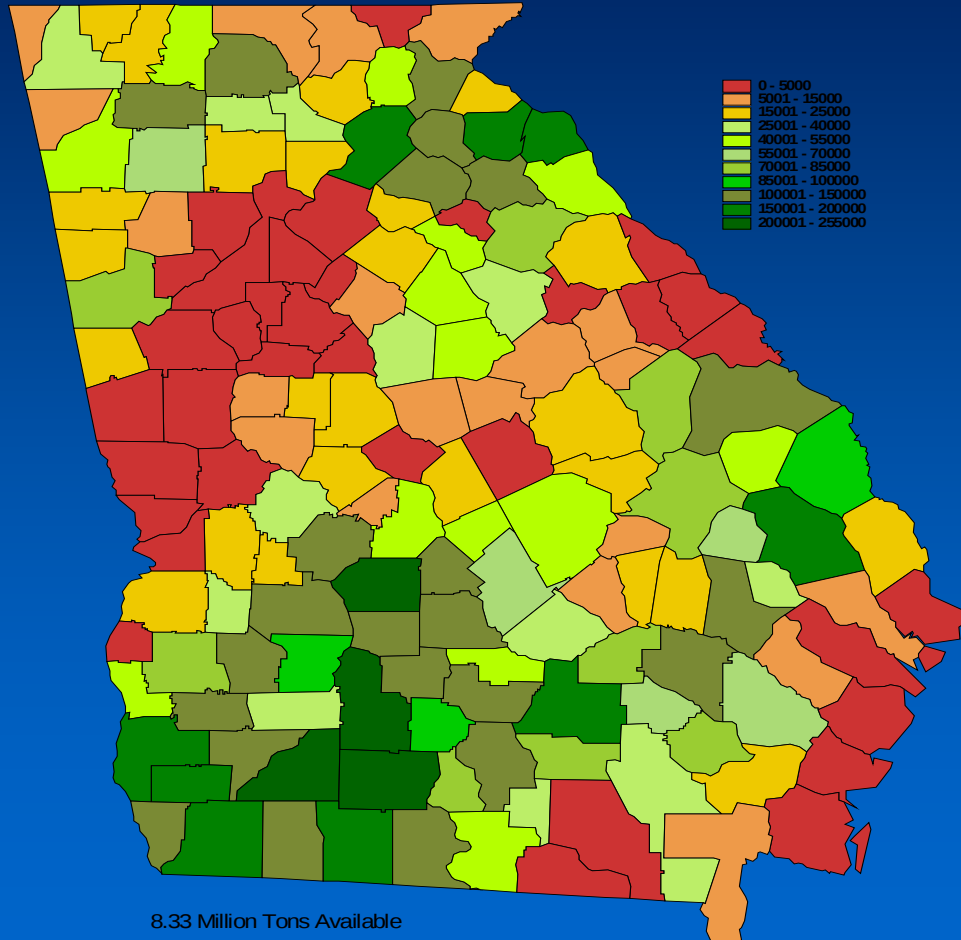
2006 - 2.86 Million Tons

Estimated Biomass Available from Ag-Related Sources (Tons)
At a Cost of \$25/ton or less

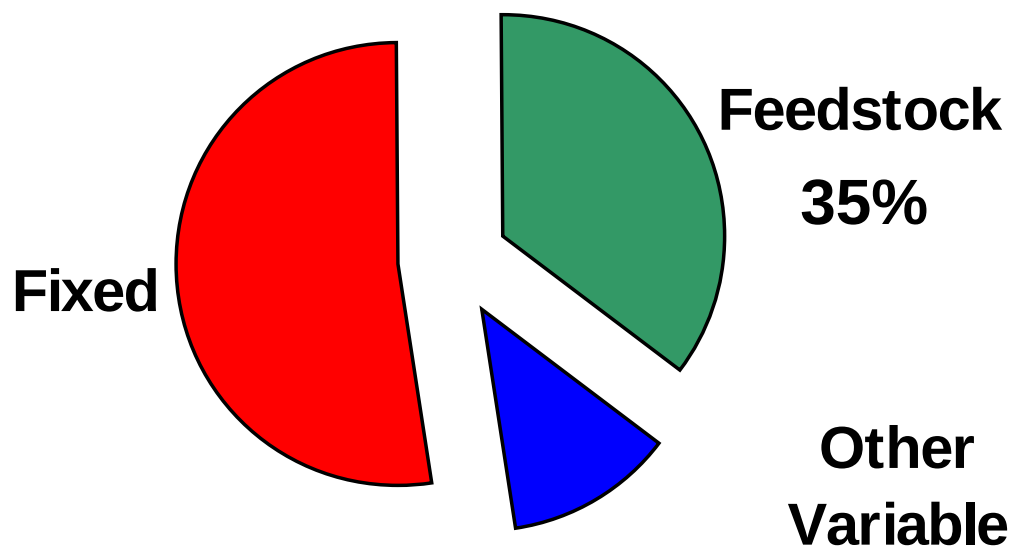


Total Agricultural By- Product Biomass Produced Less Than \$65/ton 2006 - 12.53 Million Tons

Estimated Biomass Available from Ag-Related Sources (Tons)
At a Cost of \$65/ton or less

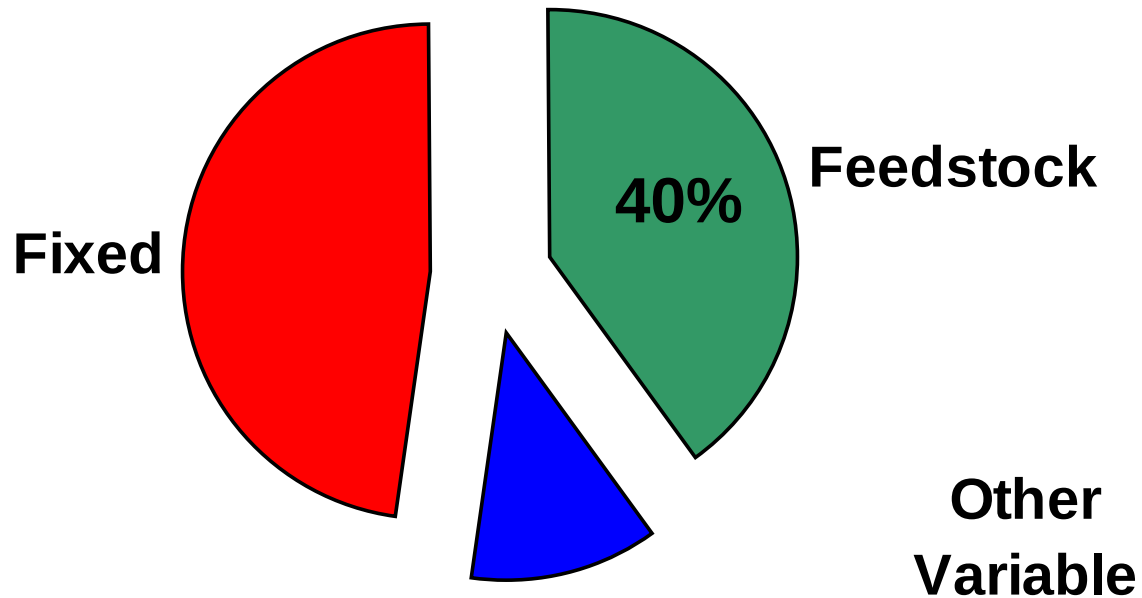


Gasification Costs



\$25/ton Feedstock Cost

Pyrolysis Costs



\$25/ton Feedstock Cost

<u>Gasification</u>	Plant Size		
	<u>160</u> <u>WTPD</u>	<u>267</u> <u>WTPD</u>	<u>533</u> <u>WTPD</u>
Production Capacity (kW)	5,956	9,924	19,848
KiloWatt Hours Per Year	50 mil	83.4 mil	167 mil
Total Estimated Capital Cost	\$19.5 mil	\$29.3 mil	\$43.8 mil
Capital Cost per kW	\$3,285	\$2,957	\$2,206
Estimated Operating Costs	\$5.5 mil	\$8.1 mil	\$13.2 mil
Operating Cost per kWhr	\$0.109	\$0.098	\$0.079

Feedstock Cost Impact on Electricity Cost

533 WTPD Gasification Plant

Feedstock Price

0
\$5
\$10
\$15
\$20
\$25
\$30

Electricity Cost

\$0.051
\$0.057
\$0.063
\$0.068
\$0.074
\$0.079
\$0.085

<u>Pyrolysis</u>	Plant Size		
	<u>160</u> <u>WTPD</u>	<u>320</u> <u>WTPD</u>	<u>480</u> <u>WTPD</u>
Production Capacity (kW)	4,064	8,127	12,191
KiloWatt Hours Per Year	34 mil.	68 mil.	102 mil.
Total Estimated Capital Cost	\$11.2 mil	\$21.2 mil	\$31.6 mil
Capital Cost per kW	\$2,764	\$2,613	\$2,590
Estimated Operating Costs	\$3.9 mil	\$7.4 mil	\$10.5 mil
Operating Cost per kWhr	\$0.115	\$0.109	\$0.103

Feedstock Cost Impact on Electricity Cost

480 WTPD Pyrolysis Plant

<u>Feedstock Price</u>	<u>Electricity Cost</u>
0	\$0.062
\$5	\$0.070
\$10	\$0.078
\$15	\$0.086
\$20	\$0.094
\$25	\$0.103
\$30	\$0.111

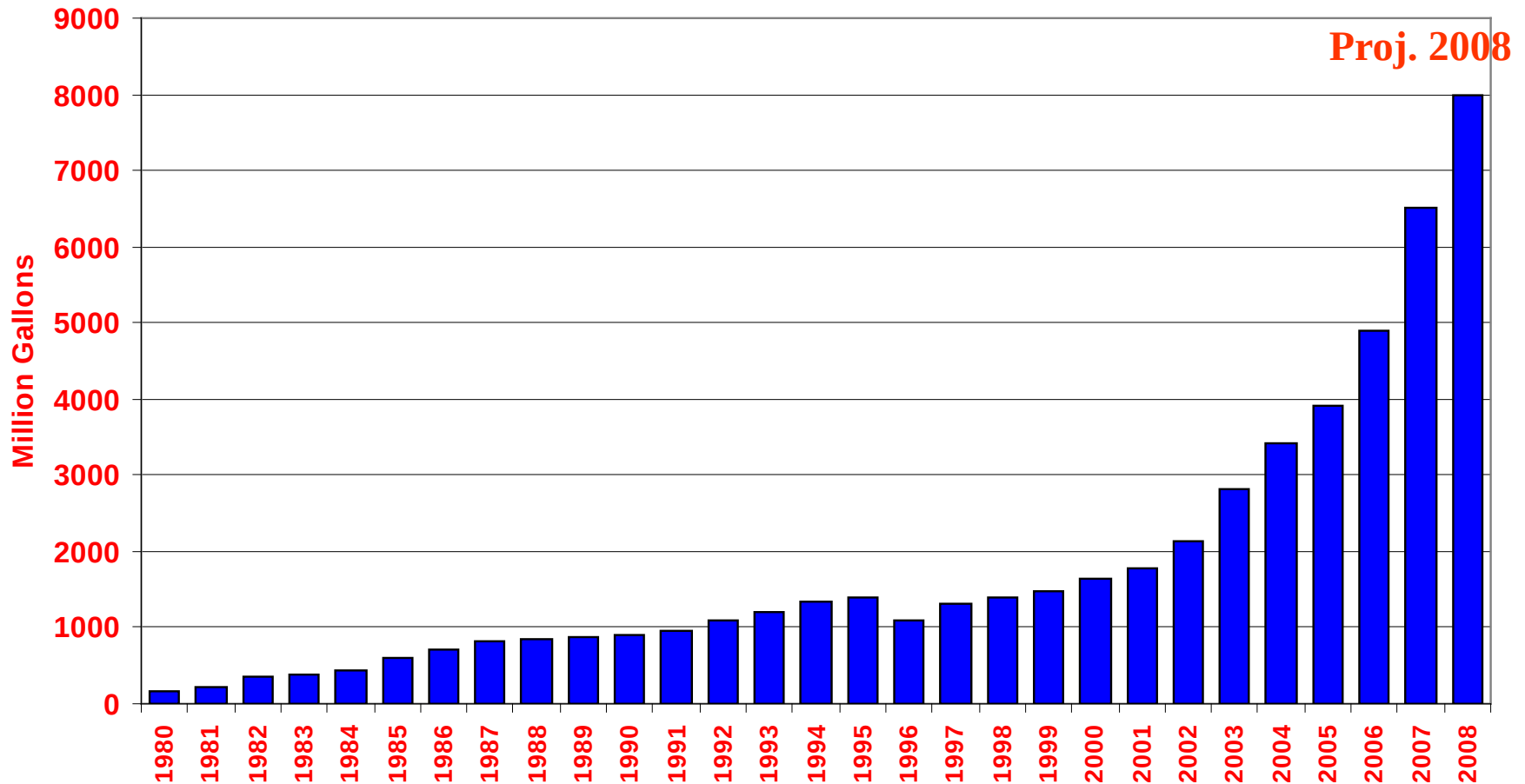
Georgia Average Retail Prices (2005 cents per KWhr) by Sector

	<u>1990</u>	<u>1995</u>	<u>2000</u>	<u>2005</u>
Residential	9.90	9.22	8.23	8.64
Commercial	9.73	8.60	7.03	7.67
Industrial	6.41	5.31	4.44	5.28
Other	10.76	10.10	9.22	6.90
All Sectors	8.70	7.77	6.72	7.43

BIOMASS TO ELECTRICITY

- 1. Technically feasible**
- 2. Economically challenging**
- 3. Cost of (Bulky) biomass –
purchase, collection, delivery**
- 4. Currently need delivered
biomass at about \$20/ton or less
to be competitive w/out subsidy**

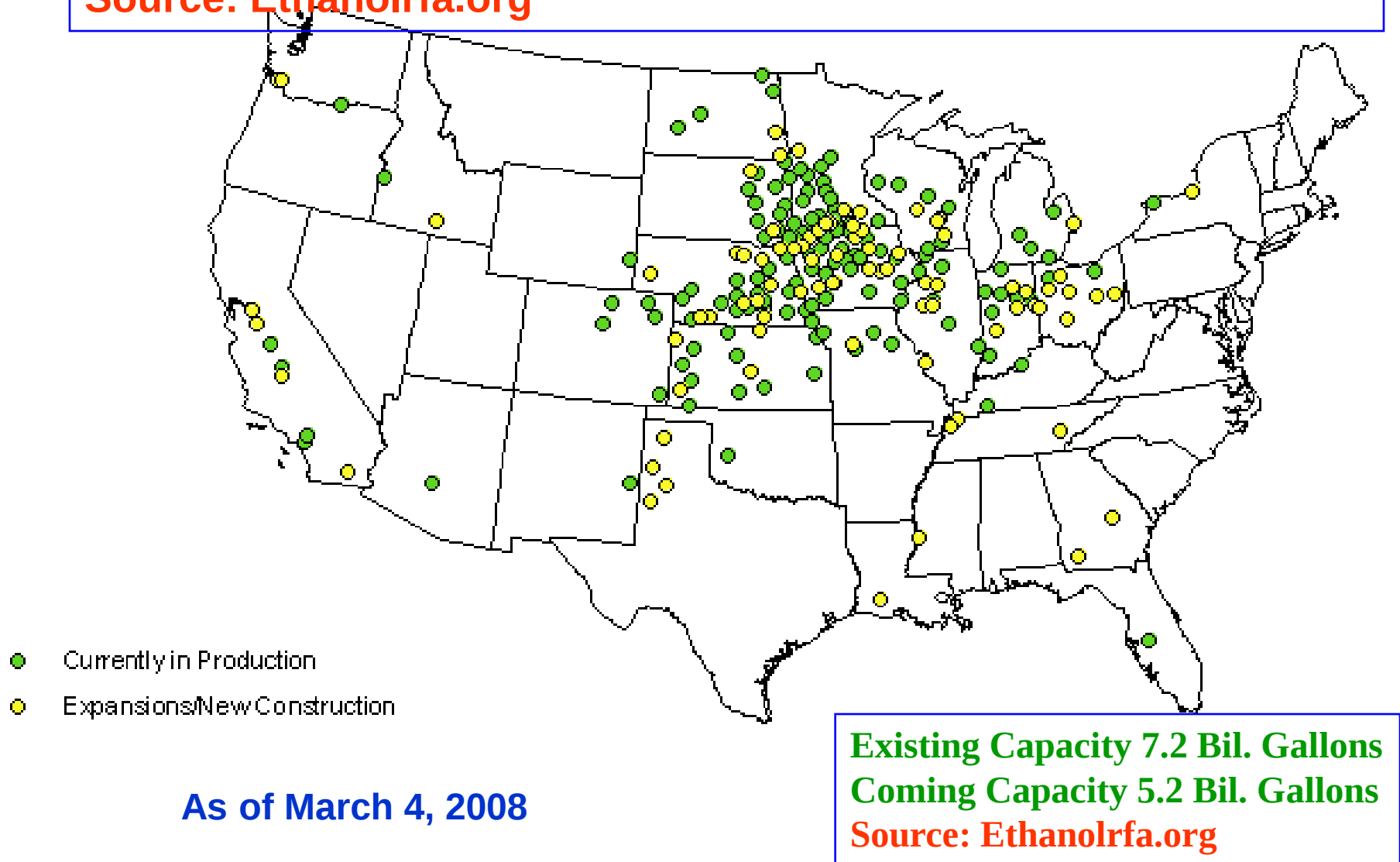
U.S. Ethanol Production



**U.S. consumes about 144 Billion gallons of gasoline per year!
Ethanol production amounts to about 3.8% of gasoline use.**

Current and Proposed Ethanol Plants

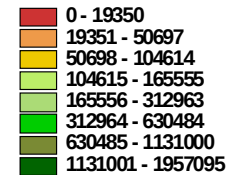
143 plants in production, 64 plants under construction/expansion
Source: Ethanolrfa.org



Corn Production, Total Bushels
(2006 Farm Gate Value Report)

Produce – 50 Mill Bu.

Use – 220 Mill Bu.

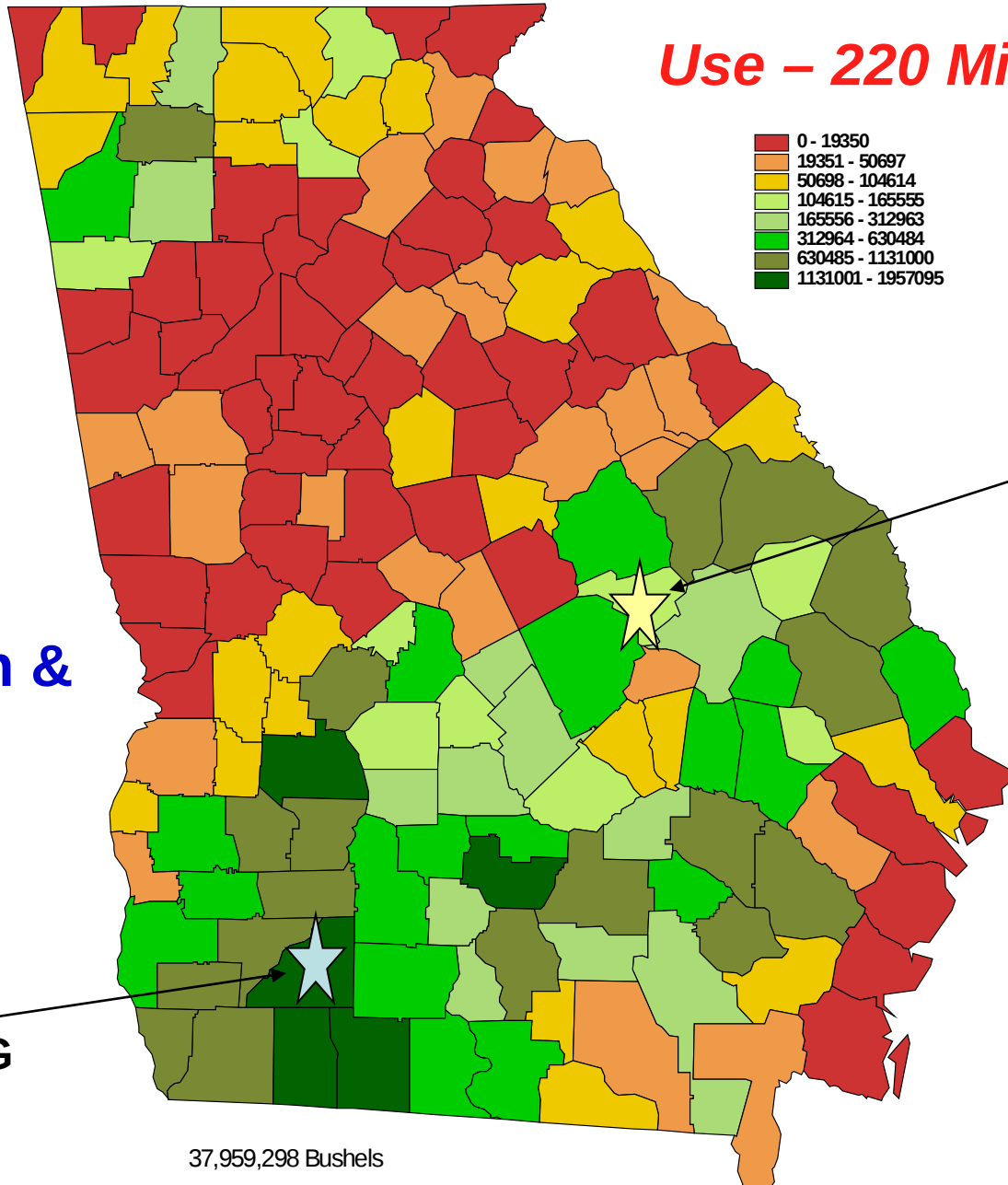


**Georgia –
Ethanol
from Corn &
Wood
Biomass**

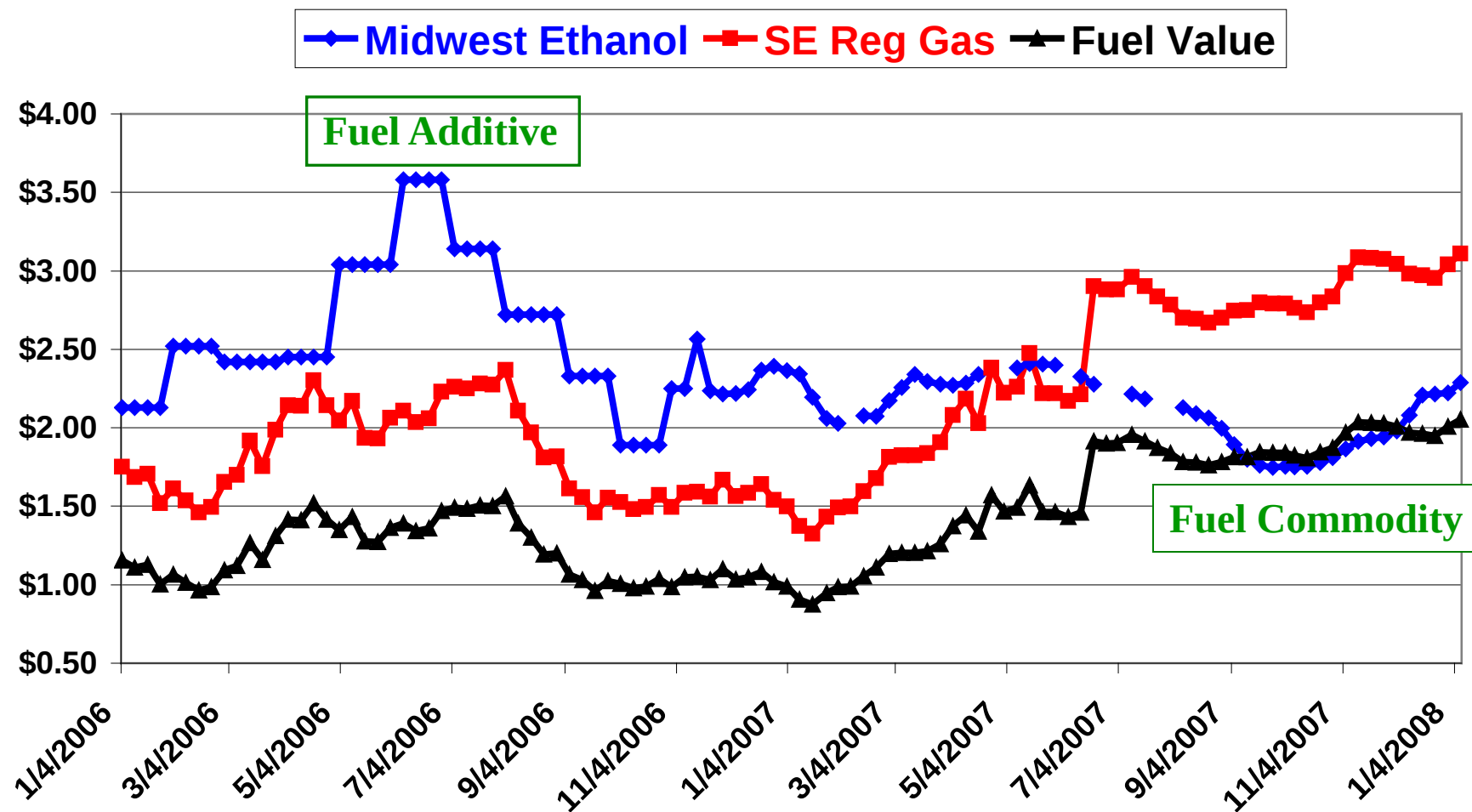
**RANGE Fuels
– 50MG
(720,000 WT
Pine/yr.,
2000/day)**

**FUEL -100 MG
(33 MB Corn)**

37,959,298 Bushels



Midwest Ethanol Rack vs SE Wholesale Regular Gas 2006 to Date



Cellulosic Ethanol Economics

Issues

- No proven commercial technology, significant production 8-10 years away. 20 MG Ga. Range Fuel Plant - 2009
- Production around 60 gallon per ton biomass. Close to Corn (96 Gallons Per Ton) when mature. 150 Gallon Theoretical. 100 MG plant would likely use around 1.8 MT/Yr
- Cost high, capital cost at least triple corn plant, operating cost higher
- Under current conditions, possible for a hypothetical plant to pay feedstock cost in \$30 to \$70/ton range
- Dedicated energy crop harvest, production and transportation cost in \$80/ton range

Energy Bill – 2007

Mandate Approach but .51/gal subsidy Ethanol, \$1 Biodiesel

- 36 BG of Ethanol by 2022 (about 8 BG now)
- 15 BG of Grain Ethanol by 2015. 8BG in 2008 up to 15 by 2015
- 100 mg of Cellulostic Ethanol in 2010. **By 2022, 16 BG**
- Biodiesel – 500 MG in 2009 up to 1 BG by 2012.

Other Ethanol Issues

- Imports of Ethanol taxed at .54/ Gal. Will expire 1/1/09.
- Blenders Credit of .51/Gal. will expire 12/31/10.
- Future Ethanol Prices???

Economic Impact of Biofuel Production Per Million Gallons

	Corn Based	Corn	Cellulosic	Cellulosic		Soybean Oil
	Ethanol	Feedstock	Ethanol	Feedstock	Biodiesel	Feedstock
Output (\$)	2,666,419	1,896,621	2,527,717	539,212	3,529,303	3,331,927
Labor Income (\$)	227,929	847,172	242,274	116,499	224,310	800,837
Employment	5	43	6	3	4	25
State Taxes ¹ (\$)	23,057	56,209	24,052	9,547	18,710	73,431
Local Taxes ¹ (\$)	20,242	41,048	20,834	5,956	14,793	57,042
Sum of Taxes ¹ (\$)	43,299	97,256	44,886	15,503	33,503	130,473

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