

The University of Georgia



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

“BioFuels – Lessons Learned From Georgia”

www.caed.uga.edu

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Potential BioFuels for Georgia

*Results of Studies for State Energy
Policy – www.caed.uga.edu*

○ **Ethanol**

○ **Biodiesel**

○ **BioMass Conversion**

Ethanol

Electricity

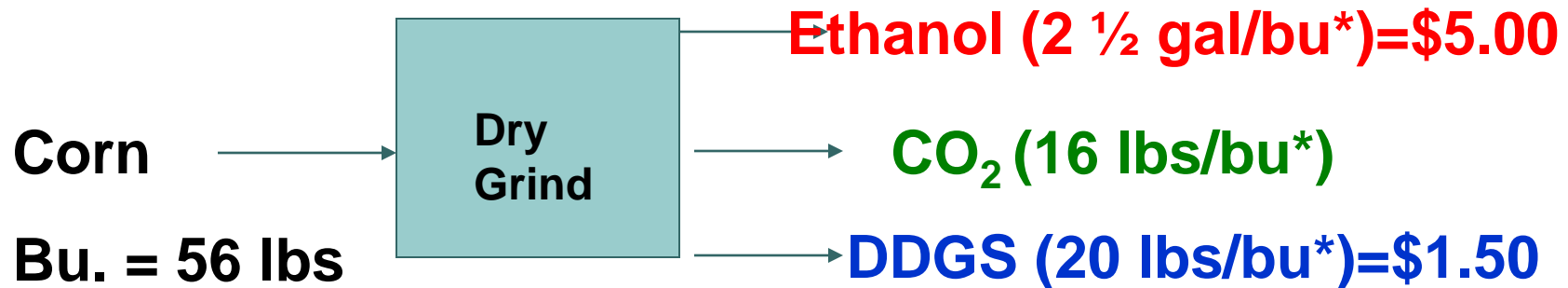
My Granddad's "Ethanol" Production Facility



The original corn value added project!

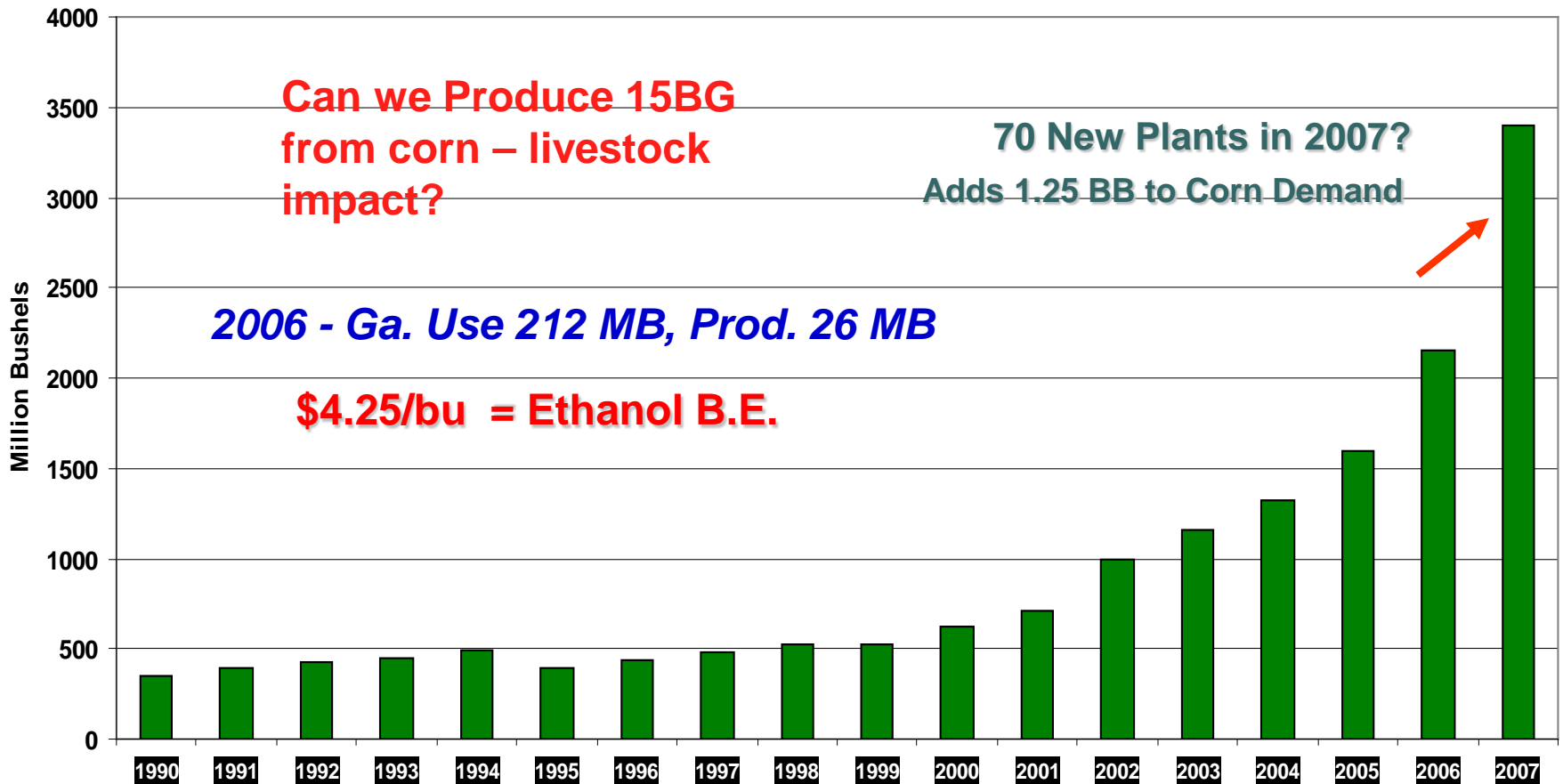
Conventional Ethanol Plant Using Corn Produces:

- Ethanol
- Distillers Dried Grain and Solubles (DDGS)
- CO₂



* Approximate

“Fueling” the Opportunities and Challenges - Corn Ethanol



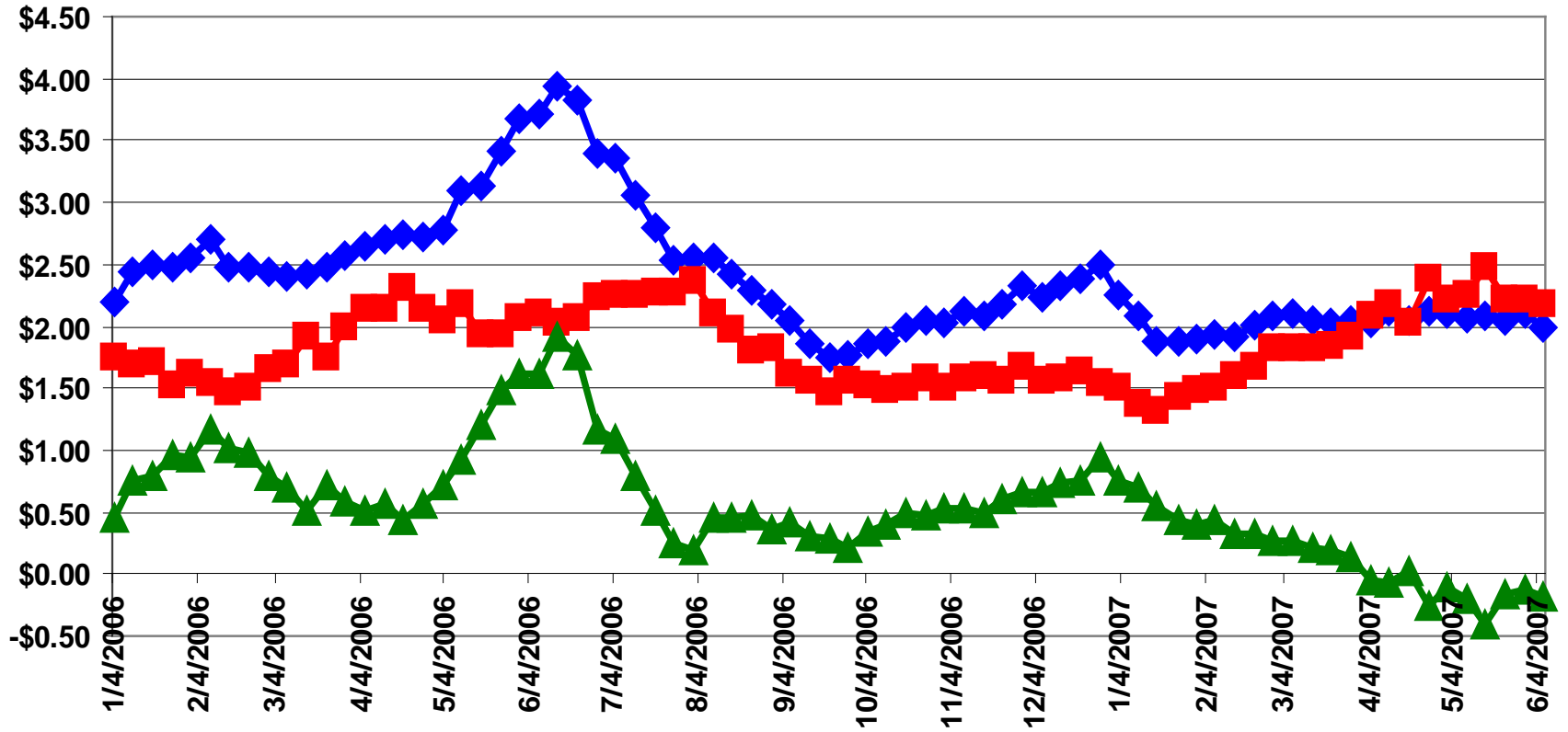
Planting Intentions: Georgia and U.S.

CROP	GA 2007 1,000 Ac	GA 2006 1,000 Ac	GA %Chg	US 2007 1,000 Ac	US 2006 1,000 Ac	US %Chg
Corn	500	280	+78.6%	90,454	78,327	+15.5%
Cotton	1,150	1,400	-17.9%	12,147	15,274	-20.5
Hay	680	650	+4.6%	63,056	60,807	+3.7%
Oats	70	70	0%	4,029	4,168	-3.3%
Peanuts	500	580	-13.8%	1,197	1,240	-3.5%
Sorghum	40	40	0%	7,109	6,522	+9.0%
Soybeans	250	155	+61.3%	67,140	75,522	-11.1%
Tobacco	19	17	+11.8%	344,170	338,950	+1.5%
Wheat	400	230	+73.9%	60,303	57,344	+5.2%

Primary data source: *Prospective Plantings, March 2008, NASS*

Ethanol Futures vs Spot Regular Gas

◆ Ethanol Futures ■ SE Reg Gas ▲ Basis



ESTIMATED CAPITAL COSTS

**\$0.90 to \$2.20
per gallon of capacity**

**100,000,000 gal con. plant
costs about \$175 million**

**Fractionation Plant - \$220
million**

ESTIMATED PRODUCTION COST

@ \$3.88 corn cost

Million Dollars

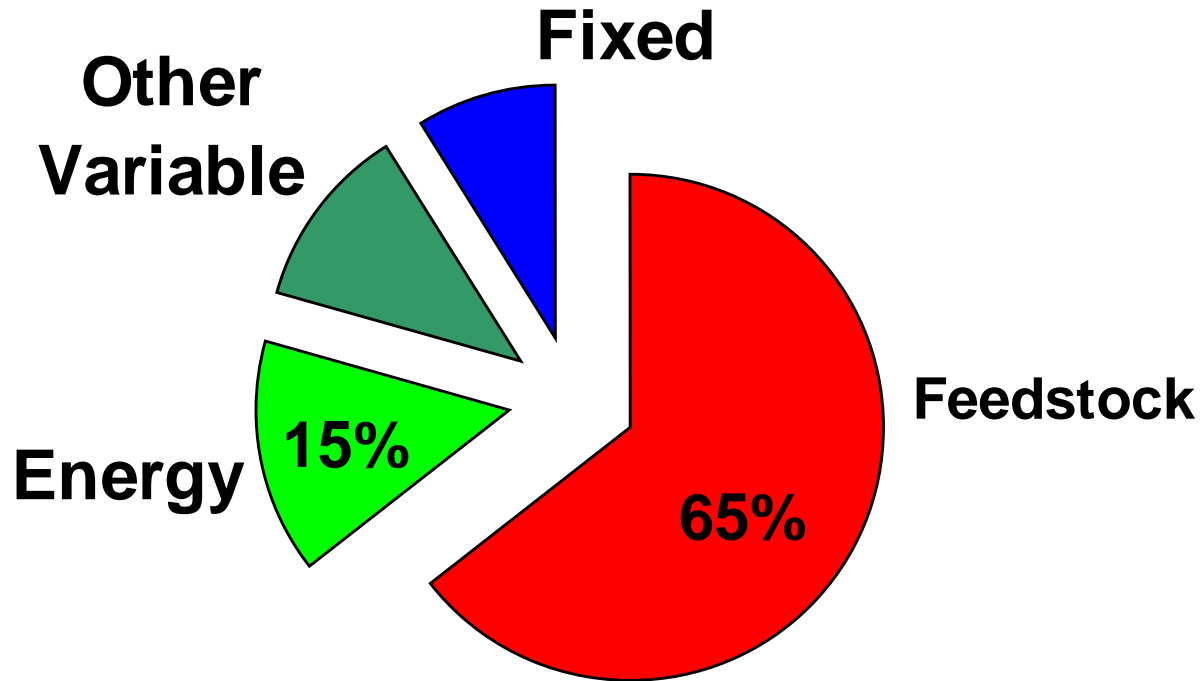
Feedstock Costs	\$138	64%
Variable Costs	\$ 57	27%
Fixed Costs	\$ 19	9%
Total	\$214	

Per gallon Conv. **\$2.14**

Fractionation **\$2.26**

Costs of Ethanol Production

100 million gallon plant



ESTIMATED REVENUE
@ \$2.37/gal Sales Price

Million Dollars

Ethanol	\$237
By-products- DDGS	<u>\$ 32.8</u>
Total	\$269.8

Per gallon Conv.	\$2.70
Fractionation	\$3.00

Breakeven Price Matrix for 100 mm Gallon Plant

Corn

Ethanol Sales Price

Price

\$1.50

\$1.75

\$2.00

\$2.25

\$3.00

\$13,123

\$25,013,123

\$50,013,123

\$75,013,123

\$3.50

(\$17,777,139)

\$7,222,861

\$32,222,861

\$57,222,861

\$4.00

(\$35,567,401)

(\$10,567,401)

\$14,432,599

\$39,432,599

\$4.50

(\$53,357,663)

(\$28,357,663)

(\$3,357,663)

\$21,642,337

\$5.00

(\$71,147,925)

(\$46,147,925)

(\$21,147,925)

\$3,852,075

	<u>\$1.50</u>	<u>\$1.75</u>	<u>\$2.00</u>	<u>\$2.25</u>
\$3.00	\$13,123	\$25,013,123	\$50,013,123	\$75,013,123
\$3.50	(\$17,777,139)	\$7,222,861	\$32,222,861	\$57,222,861
\$4.00	(\$35,567,401)	(\$10,567,401)	\$14,432,599	\$39,432,599
\$4.50	(\$53,357,663)	(\$28,357,663)	(\$3,357,663)	\$21,642,337
\$5.00	(\$71,147,925)	(\$46,147,925)	(\$21,147,925)	\$3,852,075

Biodiesel

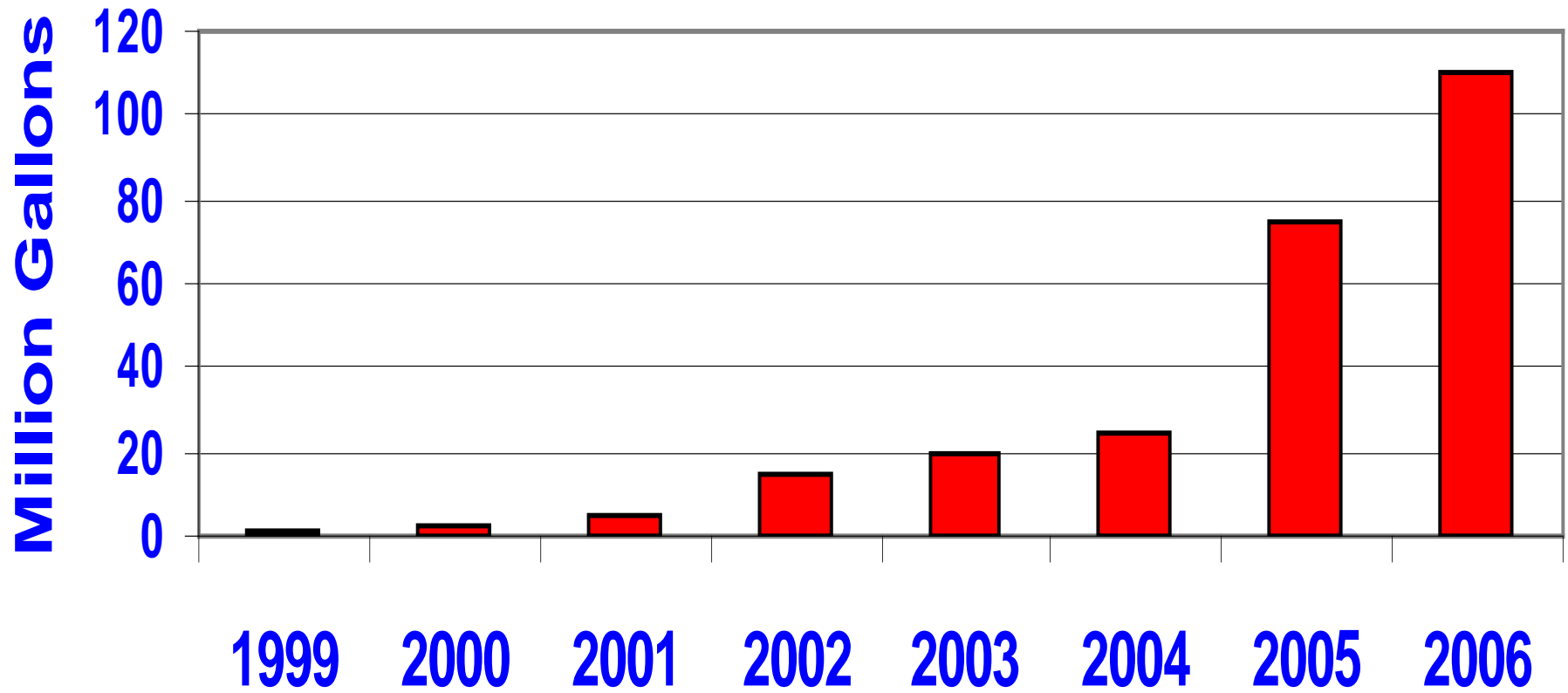
**A diesel fuel substitute
made by combining
alcohol with vegetable
oils or animal fats.**

Potential Feedstocks

***Biodiesel can be produced from any type of vegetable or animal fat.**

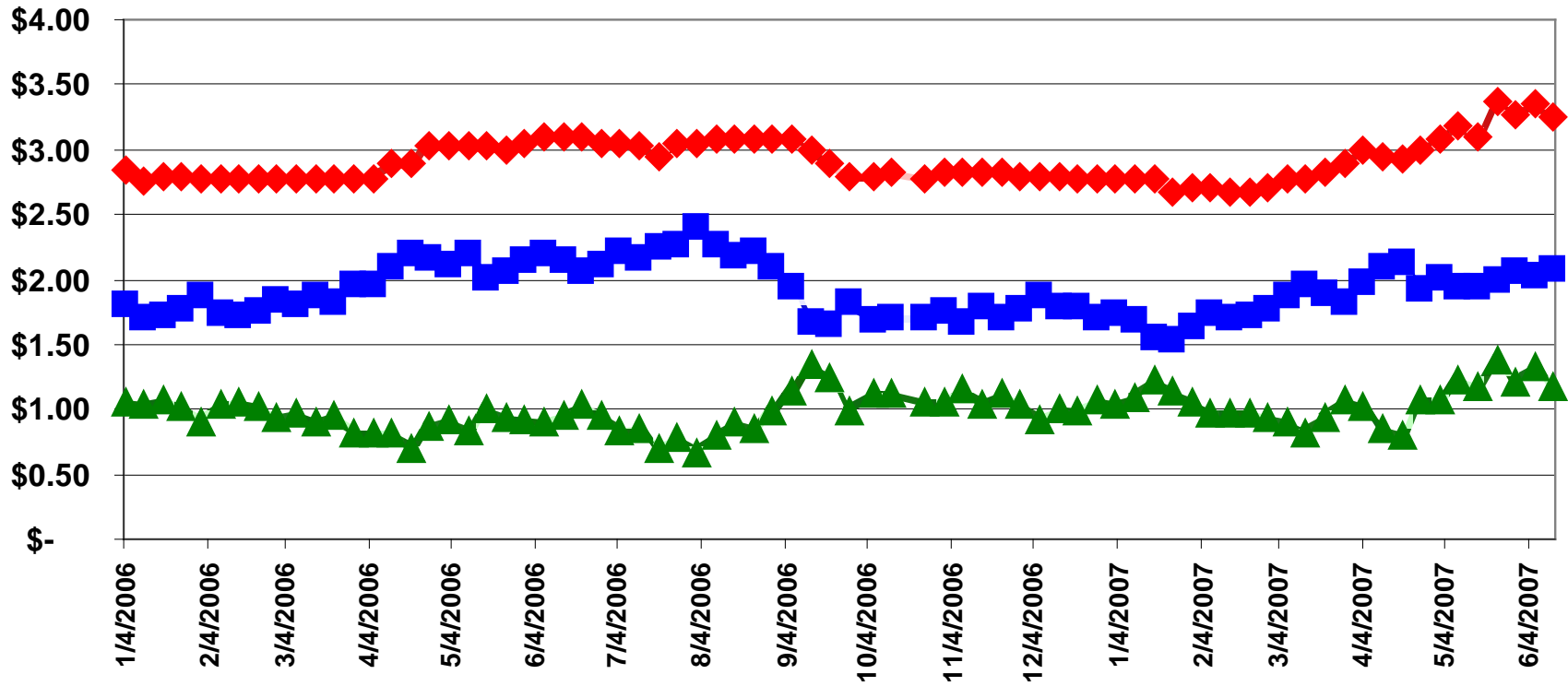
Soybean Oil, Cottonseed oil, Canola Oil, Corn Oil, Peanut Oil, Spent Restaurant Fats, Rendered Poultry Fat, Rendered Pork fat, beef Tallow

Estimated US Biodiesel Sales



Comparison of Biodiesel & Diesel Prices Jan 4, 2006 to Date

SE B100 Spot Gulf Diesel Basis



TECHNICAL CONSIDERATIONS

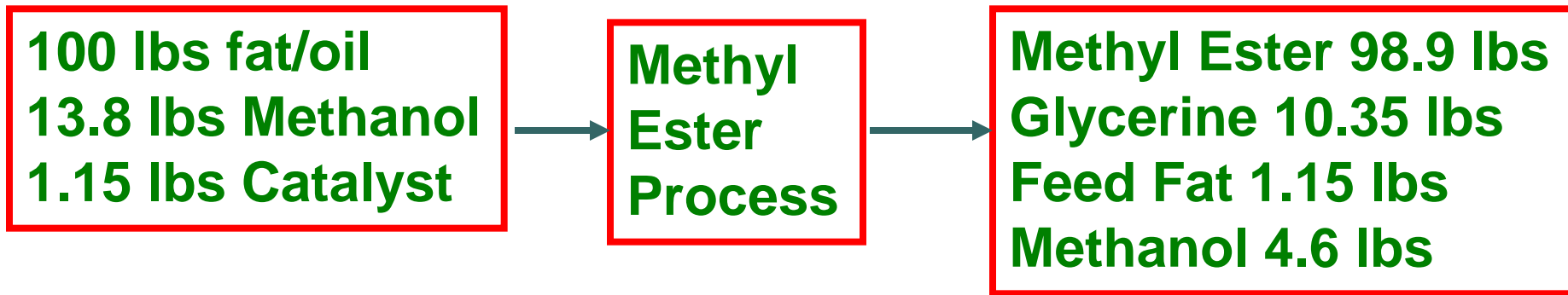
**1 bushel of soybeans yields @ 10.5 lbs oil
1.31 gal per bushel**

**1 ton peanuts yields about 960 lbs oil
128 gal per ton**

**1 ton cotton seed yields about 520 lbs oil
69 gals per ton**

Veg oils weigh about 7 ½ lbs per gallon

Methyl Ester Process



For each unit of energy used to produce biodiesel, about 3.2 units of energy are gained. Ratio for ethanol is about 1.25.

ESTIMATED CAPITAL COSTS

**\$0.90 to \$2.50
per gallon of capacity**

**15,000,000 gal plant
costs about \$33.5 million**

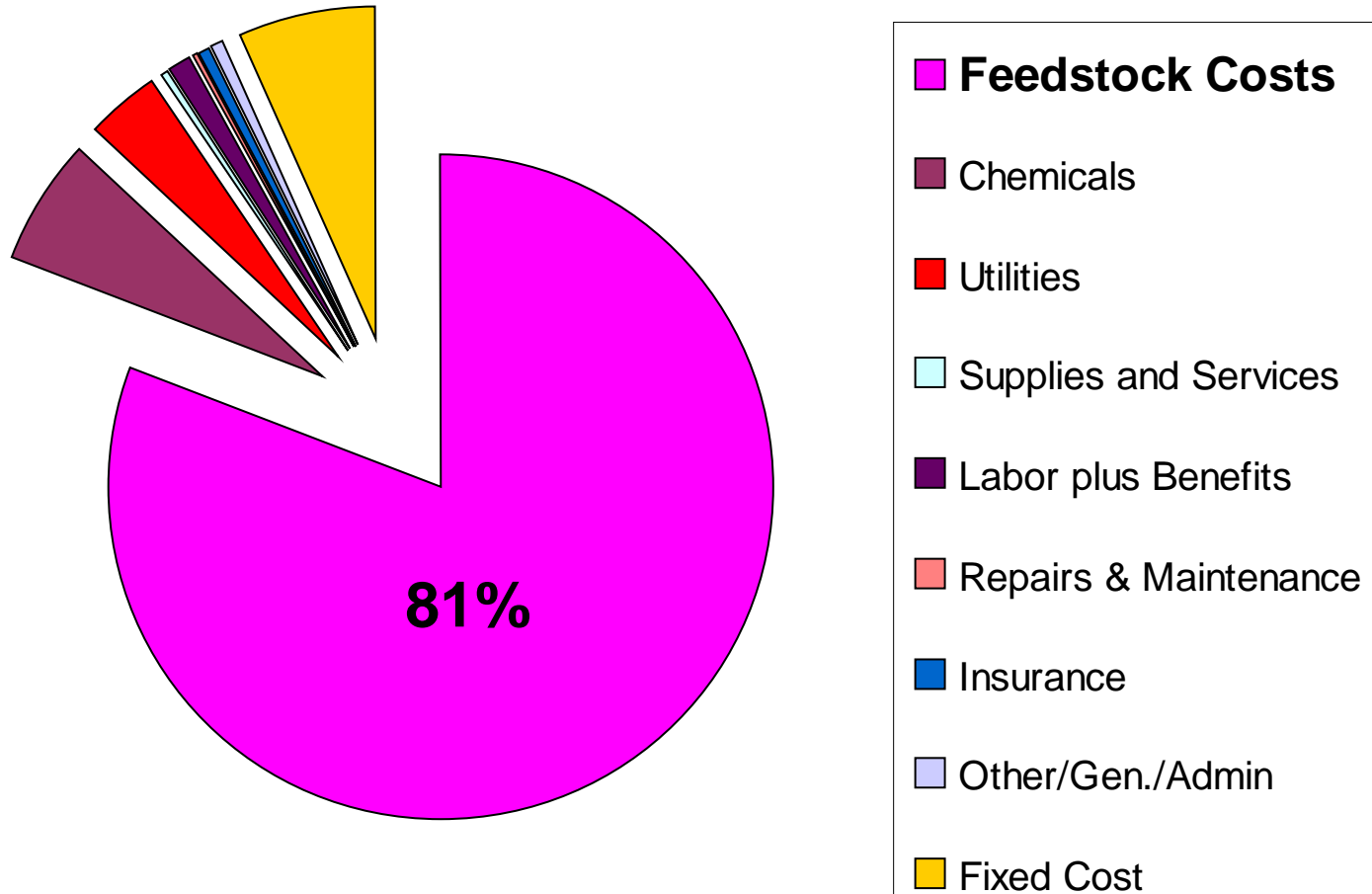
ESTIMATED PRODUCTION COST

**@ \$.36/lb Feedstock cost
30 million gallon plant**

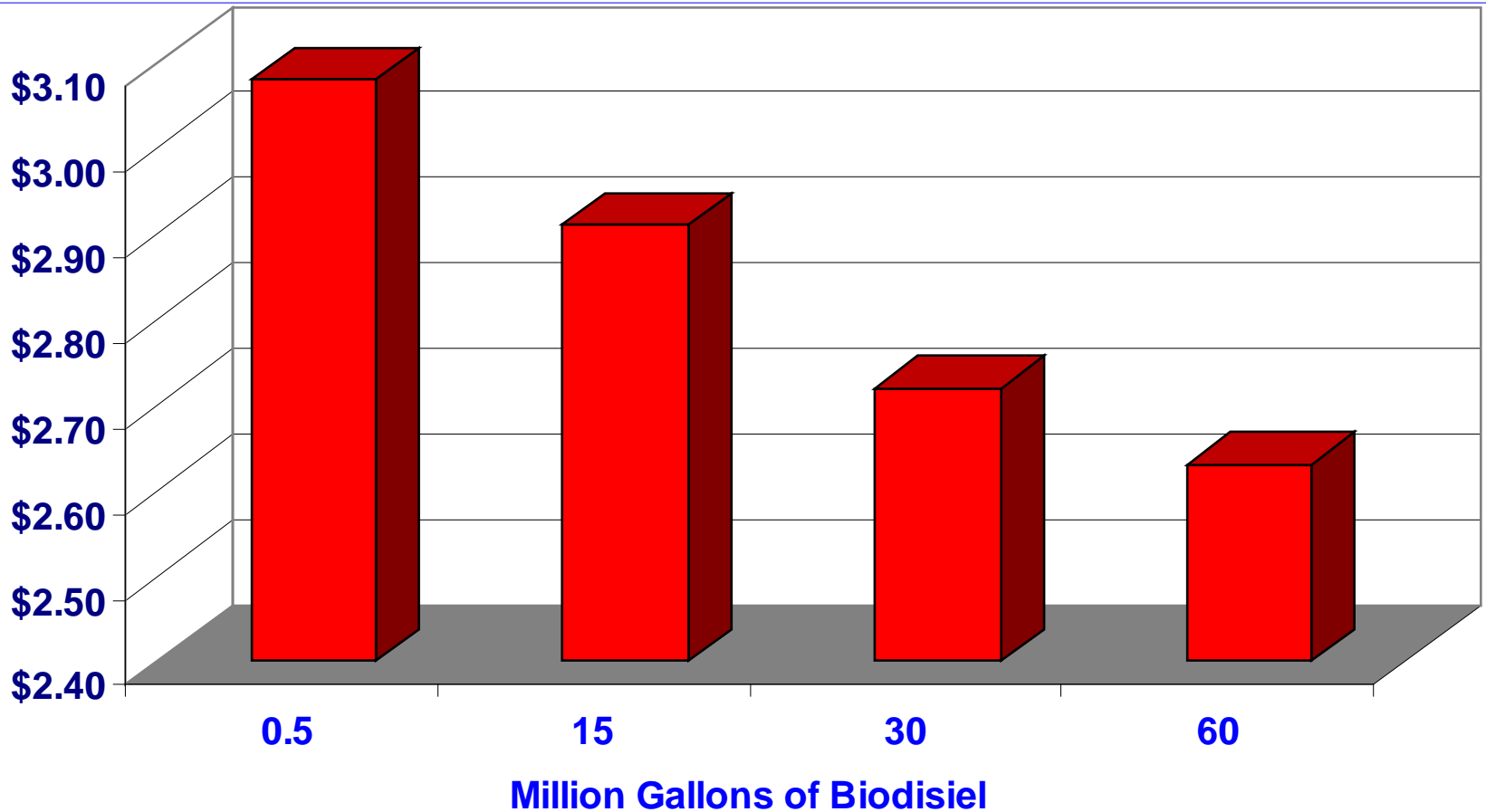
Million Dollars

Feedstock Costs	\$83.1	80%
Variable Costs	\$14.1	14%
Fixed Costs	\$ 6.3	6%
Total	\$103.5	
Per gallon	\$3.46	

Costs of Biodiesel Production 60 million gallon plant



Total Cost Per Gallon



ESTIMATED REVENUE
@ \$3.35/gal Sales Price

Million Dollars

Biodiesel	\$97.5
By-products	<u>\$ 4.1</u>
Total	\$101.5
Per gallon	\$3.39

Breakeven Price Matrix for 60 mm Gallon Plant

Feed-
stock

Biodiesel Sales Price

Price

\$2.50

\$2.75

\$3.00

\$3.25

\$0.20

\$31,596,282

\$46,596,282

\$61,596,282

\$76,596,282

\$0.23

\$17,761,727

\$32,761,727

\$47,761,727

\$62,761,727

\$0.26

\$3,927,172

\$18,927,172

\$33,927,172

\$48,927,172

\$0.29

(\$9,907,383)

\$5,092,617

\$20,092,617

\$35,092,617

\$0.32

(\$23,741,938)

(\$8,741,938)

\$6,258,062

\$21,258,062

\$0.35

(\$37,576,493)

(\$22,576,493)

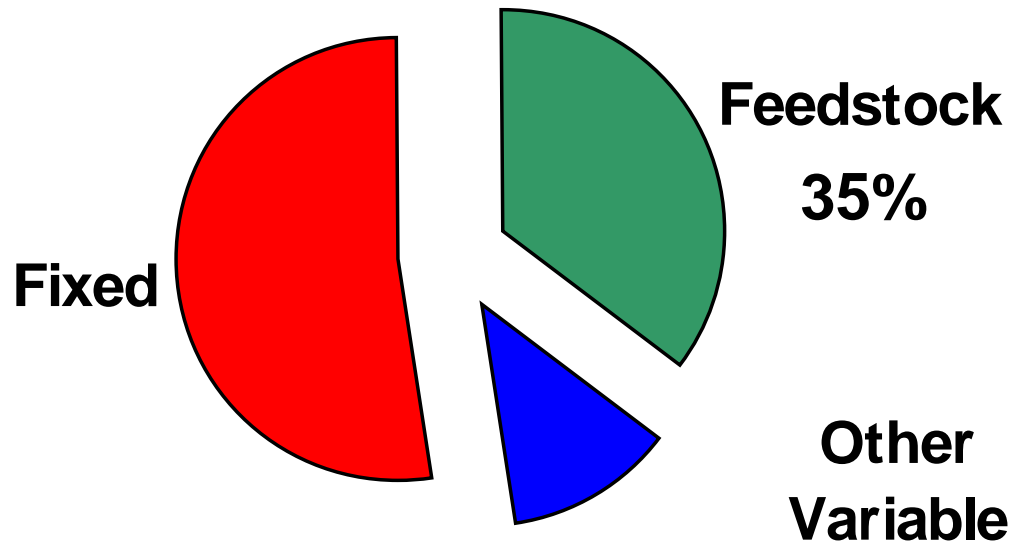
(\$7,576,493)

\$7,423,507

BioMass Conversion

- **Convert Biomass into Ethanol called “Cellulosic Ethanol”**
 - **Not yet proven on industrial scale**
 - **Very energy dependent, capital cost Ga. Plant 50mg = \$275 Mil.!**
- **Convert Biomass into electricity –What About Renewable Fuels Portfolio of 15%?**
 - **Gasification**
 - **Pyrolosis**

Gasification Costs

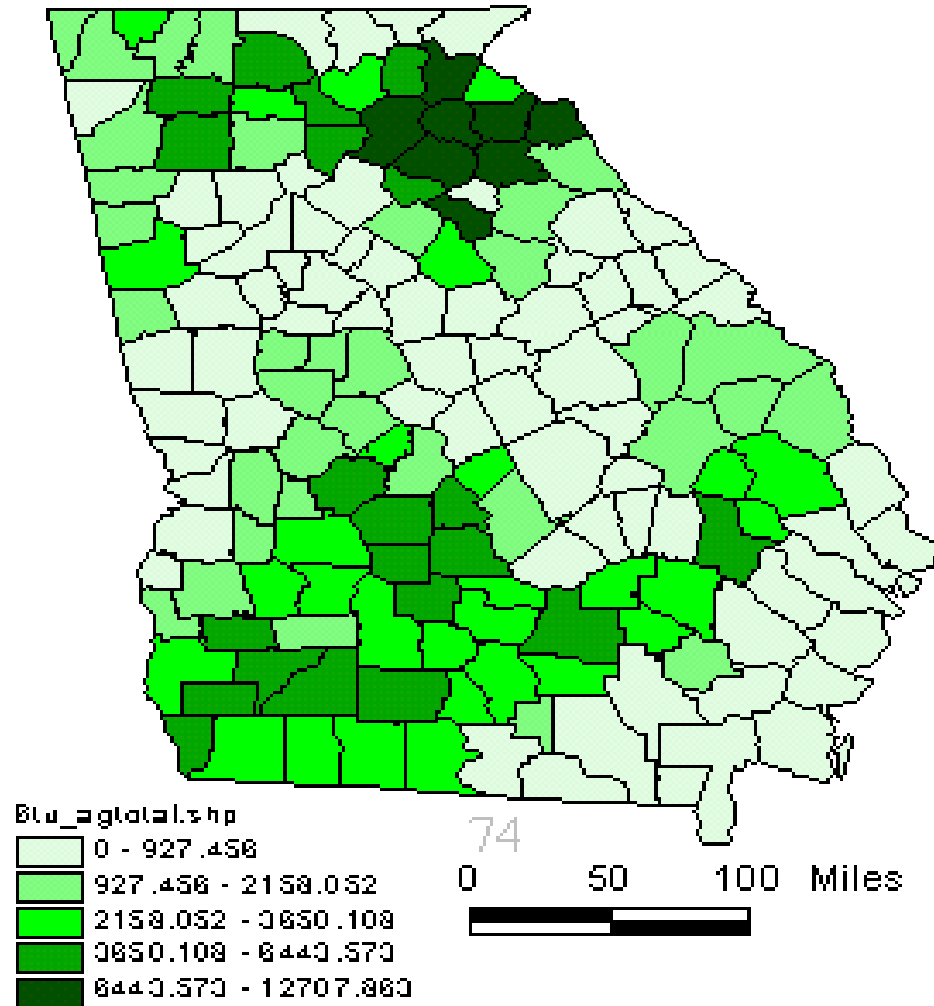


\$25/ton Feedstock Cost

Biomass Sources & Costs

○ 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

Biomass Feed Stock Availability



	Plant Size		
<u>Gasification</u>	<u>160 WTPD</u>	<u>267 WTPD</u>	<u>533 WTPD</u>
Production Capacity (kW)	5,956	9,924	19,848
KiloWatt Hours Per Year	50,032,000	83,360,000	166,720,000
Total Estimated Capital Cost	\$19,564,260	\$29,340,948	\$43,777,740
Capital Cost per kW	\$3,285	\$2,957	\$2,206
Estimated Operating Costs	\$5,452,557	\$8,128,049	\$13,240,628
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

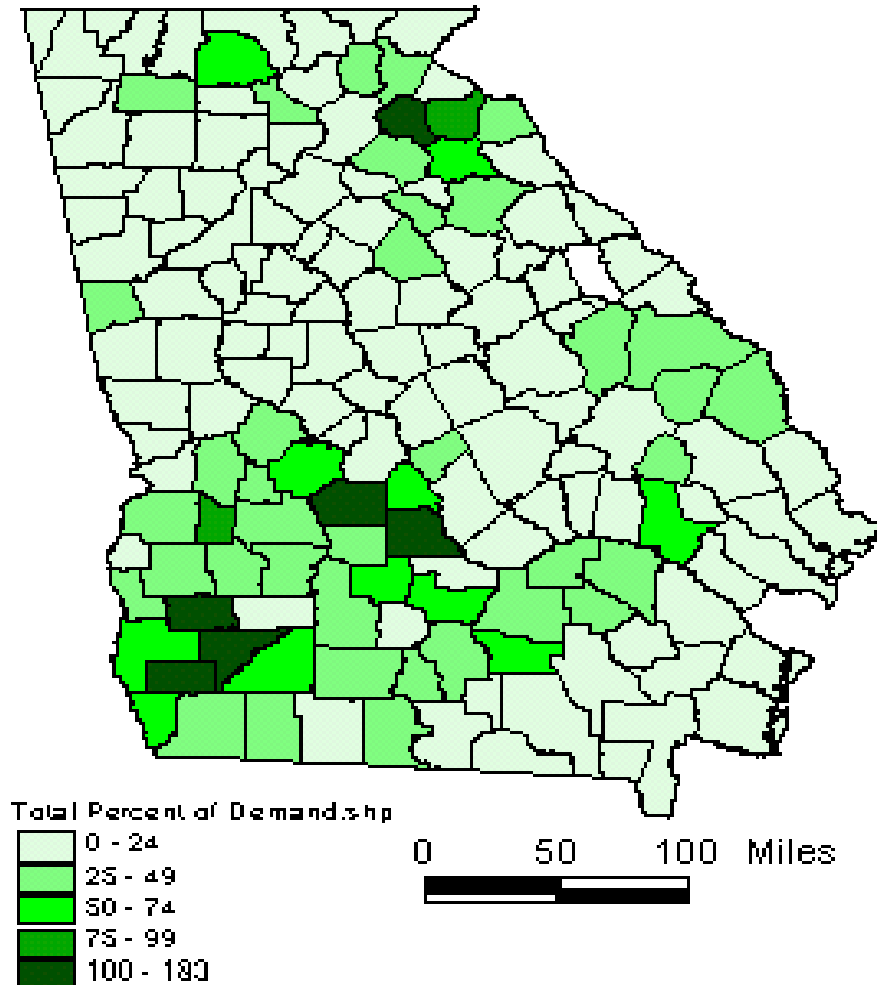
\$0.079

\$0.085

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 Generation Balance By County – Key Using Multiple Feedstocks



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 Taxes¹ (\$)	23,057	56,209	24,052	9,547	18,710	73,431
Local Taxes¹ (\$)	20,242	41,048	20,834	5,956	14,793	57,042
Sum of Taxes¹ (\$)	43,299	97,256	44,886	15,503	33,503	130,473



Any Questions?



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