Agricultural Energy: Understanding Usage Anticipating Policy Directions

Douglas G. Tiffany
College of Agriculture, Food, & Environ. Sciences
University of Minnesota

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Today's Talk

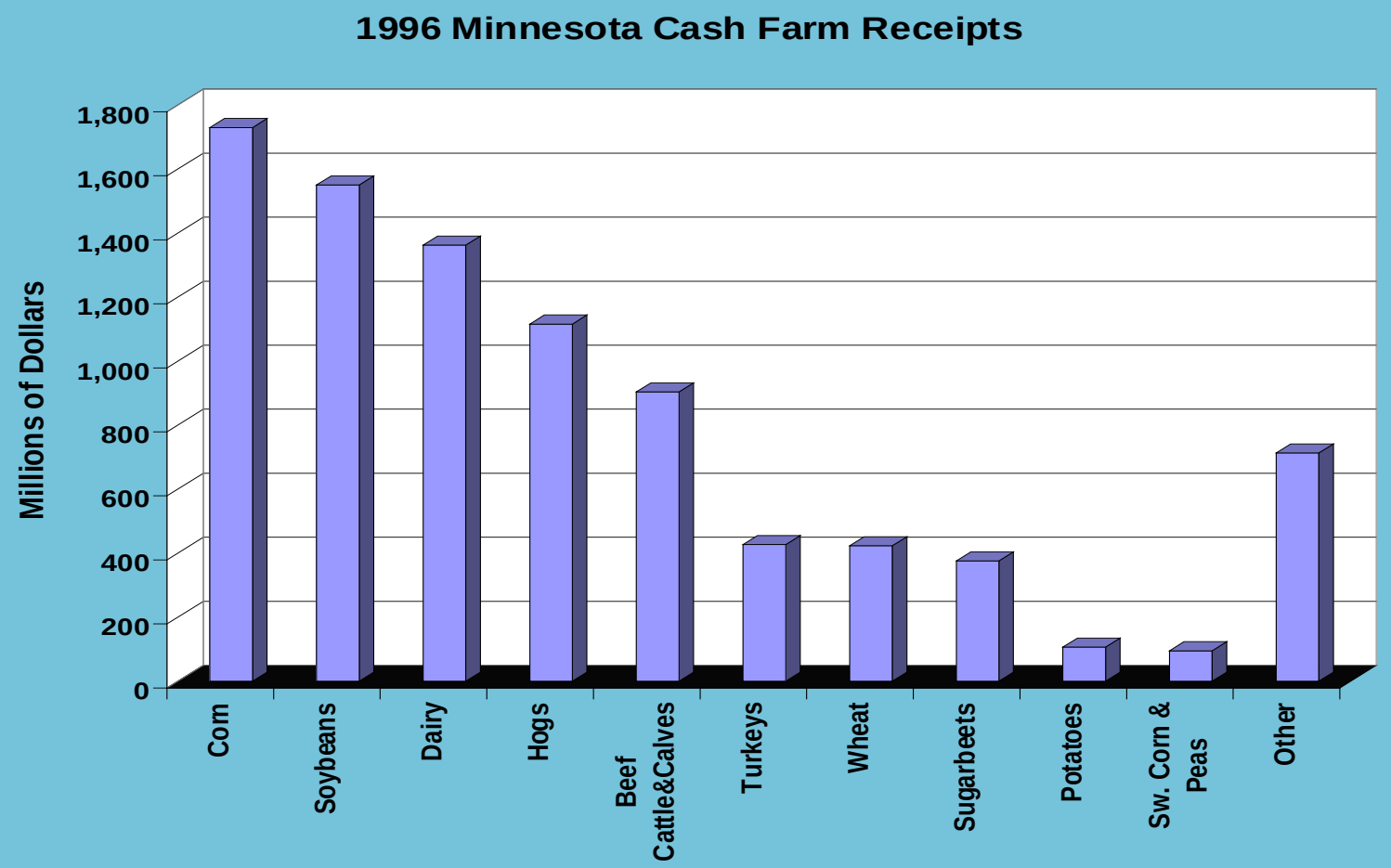
- Minnesota Agriculture is Unique, Diverse, & Geographically-Dispersed.
- Review History of Farm Energy Efficiency
- Examine Minnesota Ag. Energy Use
  - Farm, Transportation, Processings
- Discuss Implications of Kyoto Accord/Climate Change Debates--- Standardize Energy
- Review Ag. Policy - Energy Policy Link
- Suggest Farmer/Industry Responses to Change

Sharing Elements of Four Projects Today

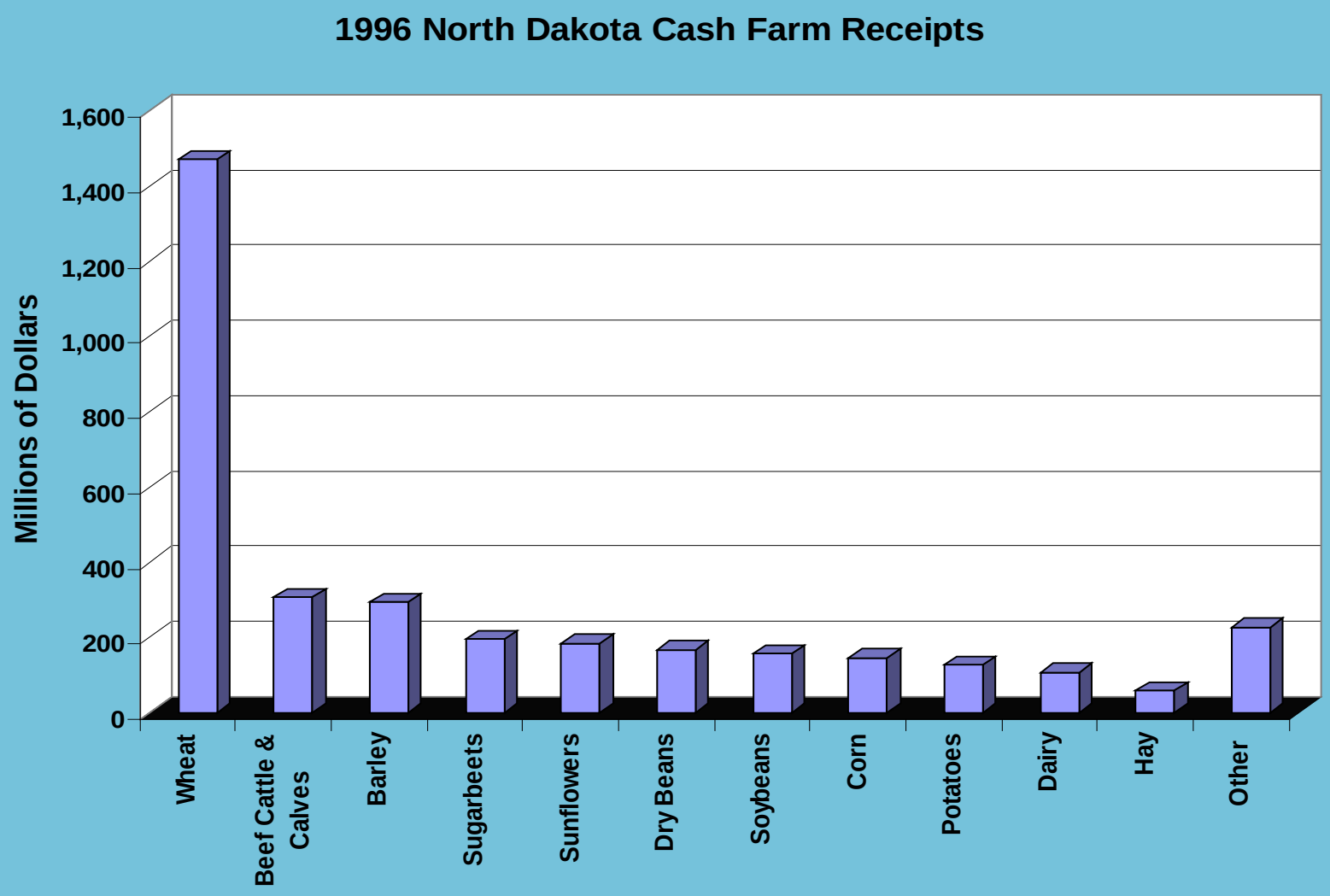
- **Project for ILSR and ME3 conducted with Barry Ryan, U of M**
- **Project for Industrial Commission of N.D. conducted with Dwight Aakre, N.D.S.U.**
- **Minnesota Grain Flow Project with Jerry Fruin for MN Grain Transportation Consortium**
- **My Previous Work on Biodiesel and Ethanol Production Economics and Policy Work**

Minnesota Ag. Products

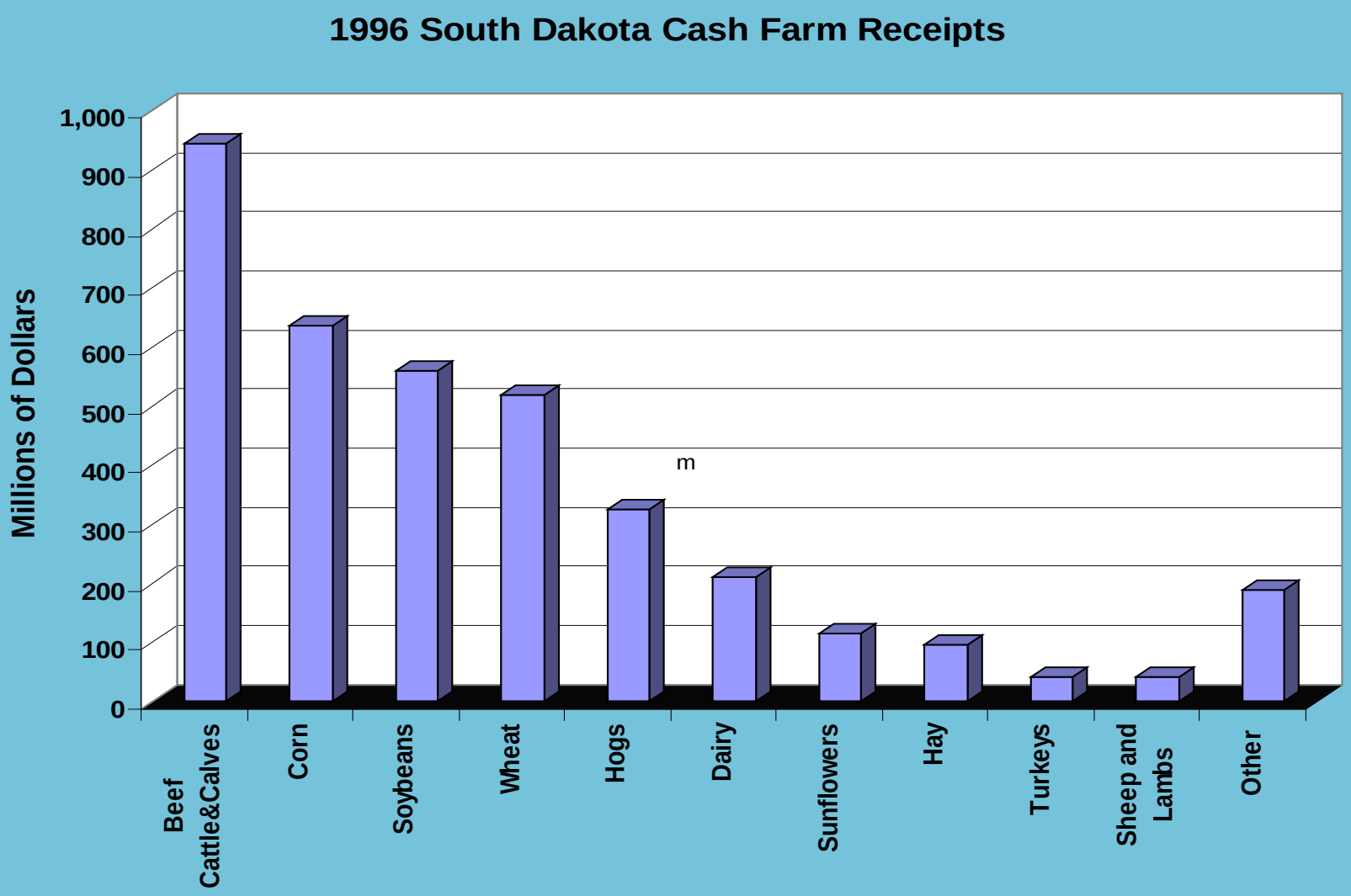
1996 Minnesota Cash Farm Receipts



1996 North Dakota Cash Farm Receipts



1996 South Dakota Cash Farm Income



Energy Efficiency in U.S. Agriculture 1978-94

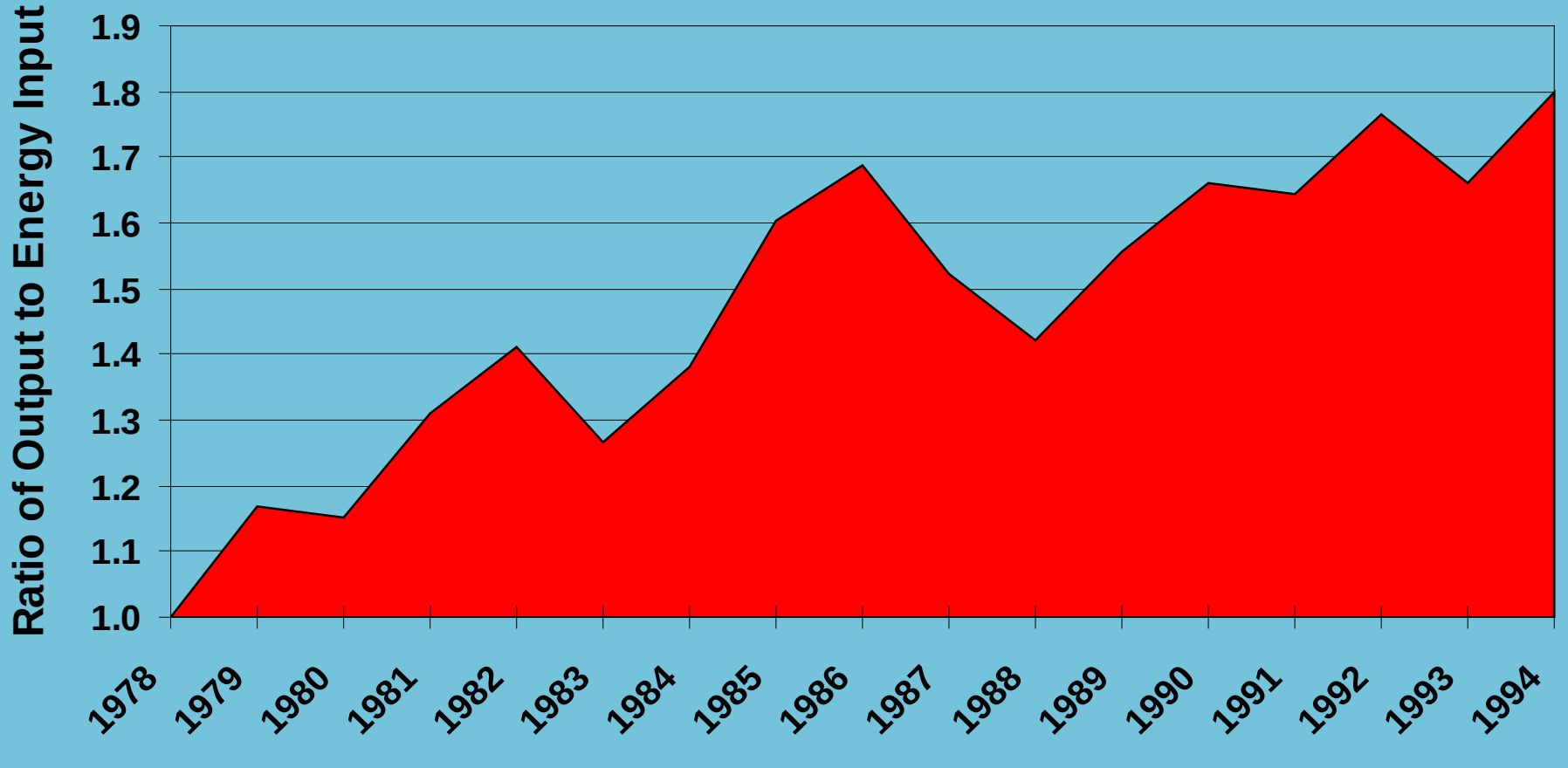
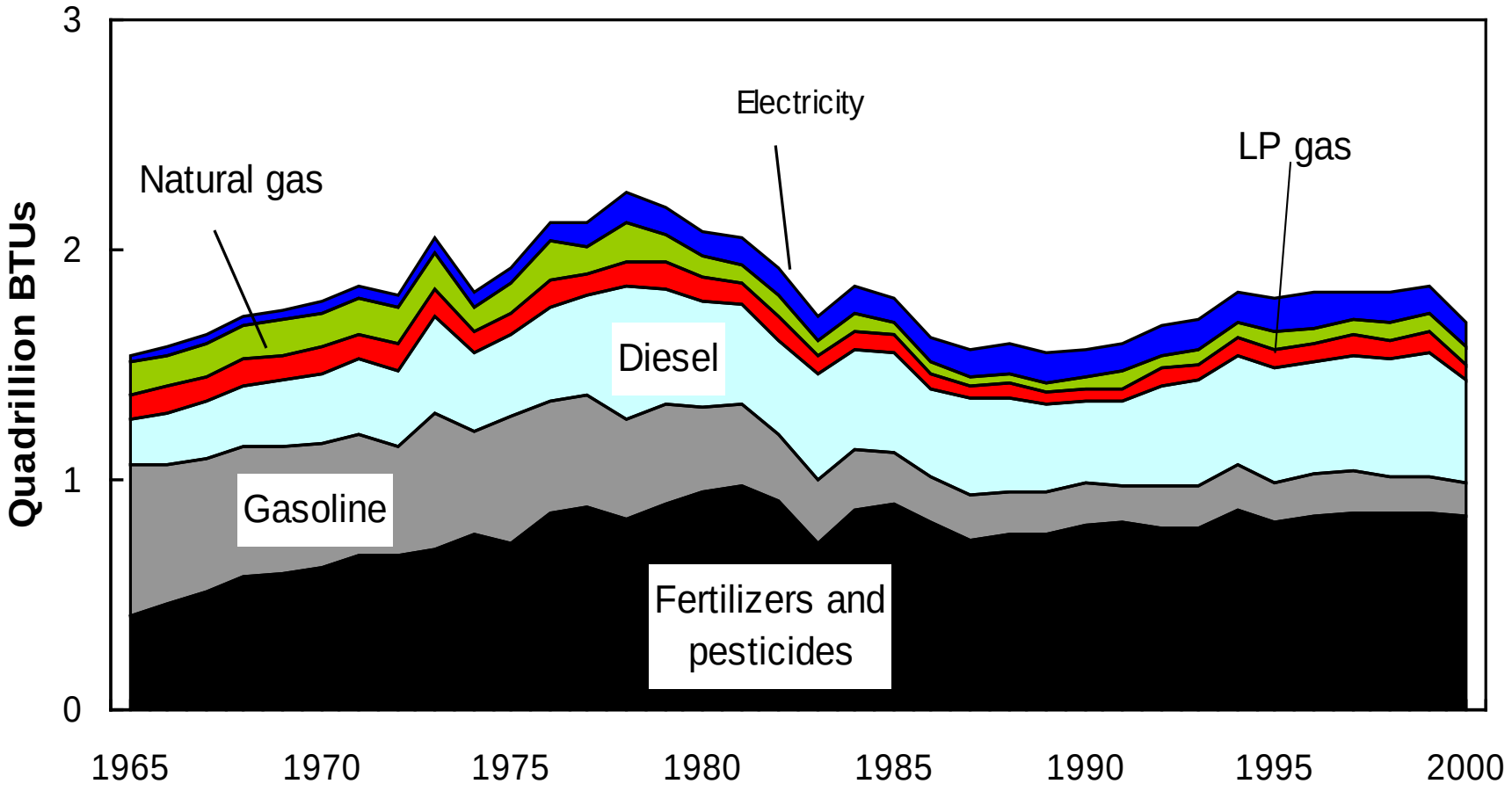
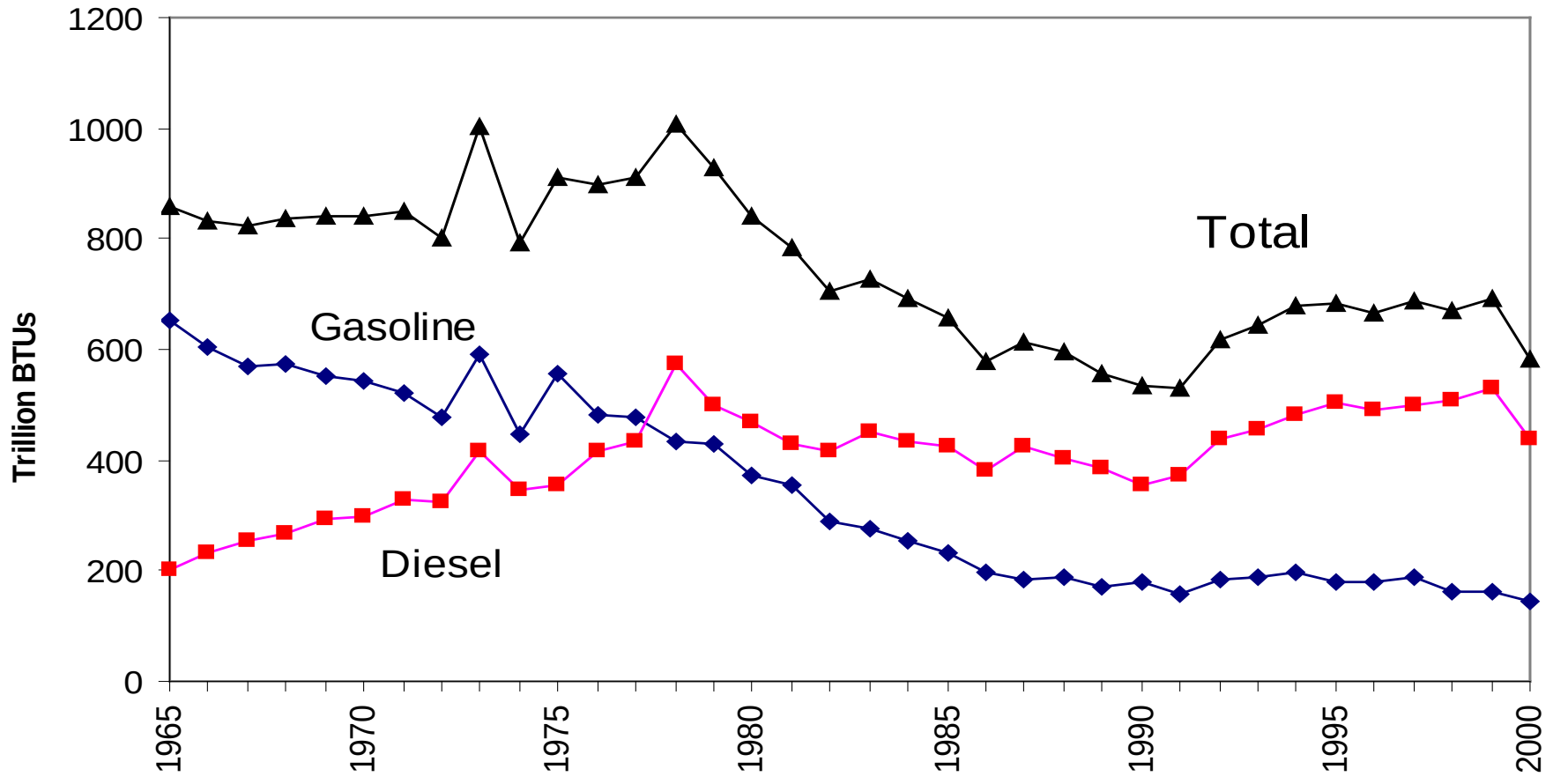


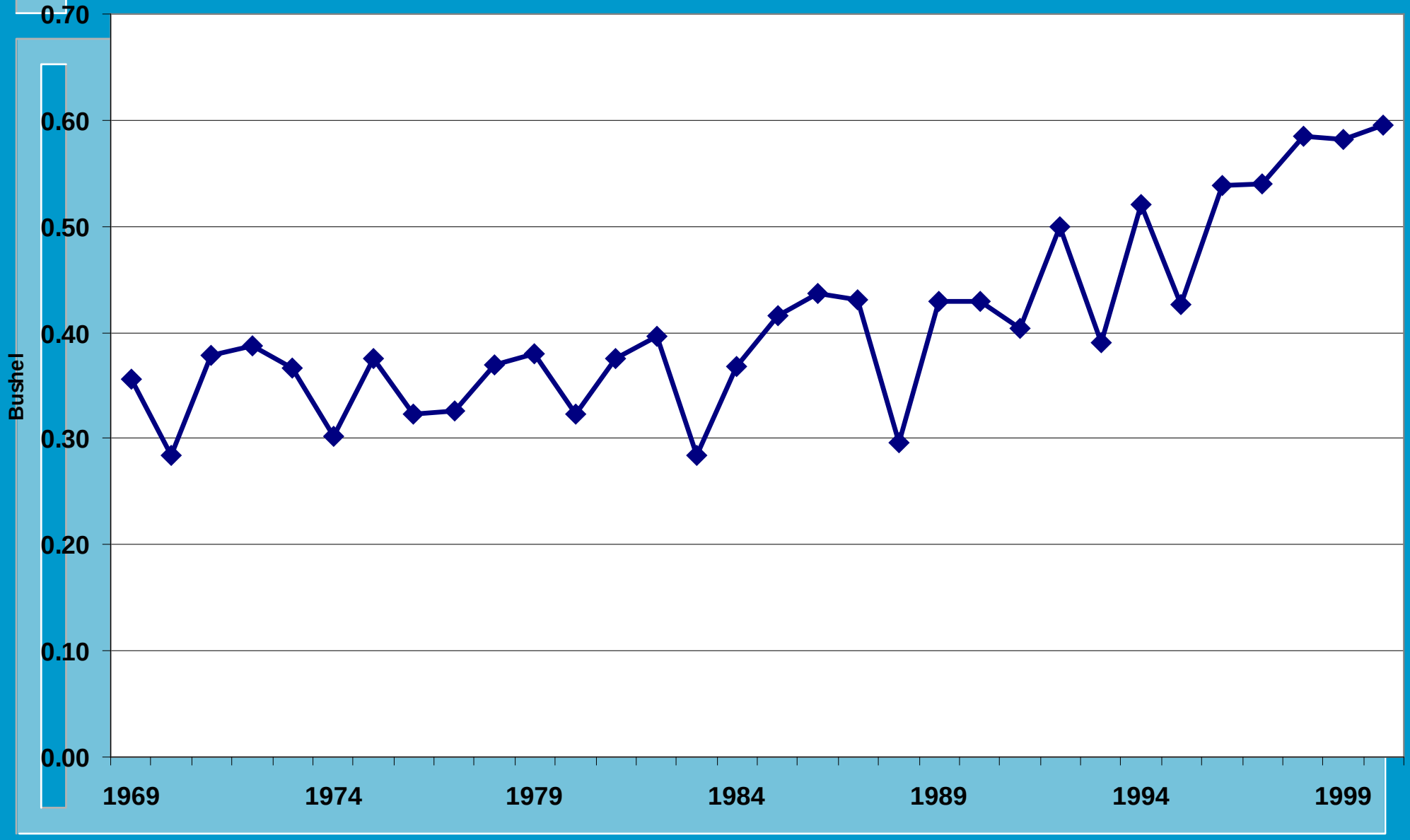
Figure 5 -- U.S. agriculture has been using less energy since the late 1970s



Energy use in ag. has declined since 1978 due to replacement of gasoline-powered machines with diesel engines.



Bushels of Corn per Pound of Fertilizer



Direct Energy: Fuel Consumed

Indirect Energy: Herbicide Substituted for Direct Energy

Fertilizer: Indirect or Imbedded Energy

Anhydrous Ammonia	**24.019 scf/lb. N**
Urea	**33.384 scf/lb. N**
28% Liquid N	**28.437 scf/lb. N**
N in DAP	**24.019 scf/lb. N**
P2O5 in DAP	**-0- scf/lb. N**
Muriate of Potash	**6.834 scf/lb. K2O**

MN On-Farm Energy Use--Crops

Crop	Diesel	Gas	LP	Elect	NG
Corn	9.37	1.15	9.58	35.63	3.945
Alfalfa	9.80	.81	-0-	37.23	.719
Soybean	7.43	.91	.75	27.50	.199
S.beets	28.92	2.00	-0-	100.75	2.950
Irr. Pot.	48.89	2.00	-0-	319.22	8.801
Dry.Pot.	24.18	2.00	-0-	205.27	2.931
Wheat	7.24	.89	.82	29.88	1.749

MN On-Farm Carbon Emissions from Crop Production (MT/A.)

Crop	Fuel	Fert	TotalMT./A
Corn	.0539	.0639	.1178
Alfalfa	.0393	.0116	.0510
Soybean	.0317	.0032	.0349
Sugar Beets	.1477	.0478	.1955
Irrg. Potatoes	.2182	.1426	.3608
Dryland Potatoes	.1203	.0475	.1678
Wheat	.0316	.0283	.0600

MN On-Farm Carbon Fees-Crops

Crop	Fuel	Fert	Tot.@$100	Tot. @$265
Corn	5.39	6.39	$11.78	$31.23
Alfalfa	3.93	1.16	$ 5.10	$13.51
Soybean	3.17	.32	$3.49	$9.24
S.beets	14.77	4.78	$19.55	$51.79
Irr. Pot.	21.82	14.26	$36.08	$95.60
Dry.Pot.	12.03	4.75	$16.78	$44.45
Wheat	3.16	2.83	$6.00	$15.89

Production: Cow-Calf

MN On-Farm Livestock Energy Use

Species	Diesel	Gas	LP	Elect.
Dairy(15,000#)	34.50	3.00	16.50	600.00
Turkey(hd.)	.10	.01	.50	1.24
Sw.Farrow(lit.)	9.55	1.11	4.06	148.25
Sw. Finish(hd.)	1.11	.11	.34	12.38
Beef Cow(hd.)	6.37	.74	1.62	59.25
Beef Finish(hd.)	4.78	.46	1.08	39.38

MN Farm Livestock Carbon Emissions from Fuels and Energy

Species	MT/ Unit
Dairy Cow (15,000 lb.)	.2550
Turkey (hd.)	.0014
Swine Farrow (litter)	.0686
Swine Finishing (hd.)	.0067
Beef Cow (hd.)	.0359
Beef Finish (hd.)	.0254

If Carbon Permit Fees Were Collected in Kyoto Framework:

The Kyoto Accord

- U.N. Committee of the Parties-3 12/97
- COP-4 Meeting in Buenos Aires 11/98
- U.S. signed treaty to reduce greenhouse gas production to 7% below 1990 levels between 2008 and 2012.
- Administration position assumes “permit trading”,credits for “carbon sinks”
- Treaty never submitted for ratification—concern about China & India
- Dropped from further Consideration at Beginning of Bush Admin.--- No Senate Support--- Considering Other Mechanisms

Carbon Permit Fees: the Range

- $100/ mt of carbon---- Administration Position----assumes international trading of carbon emissions
- $265/ mt of carbon---- produced by Wharton Econometric Forecasting Associates (WEFA)--- assumes no international trading or credits for carbon sinks (EIA model concurs)

Alternative Carbon Permit Fees

		$100/MT	$265/MT
Diesel	Gal.	$.3020	$.8003
Gasoline	Gal.	$.2640	$.6996
LP Gas	Gal.	$.1600	$.4240
Natural Gas	Mcf	$1.620	$4.293
Electricity	kWh	$.02732	$.07239
Coal	Ton	$50.36	$133.45

MN Farm Lvstk. Carb. Permit Fees

Species	@$100/mt	@$265/mt
Dairy(cwt.)	$.17	$.46
Turkey(hd.)	$.14	$.37
Sw.Farrow(lit.)	$6.86	$18.17
Sw. Finish(hd.)	$.67	$1.78
Beef Cow(hd.)	$3.59	$9.51
Beef Finish((hd.)	$2.54	$6.74

MN Farm Agg. Carb Permit Fees

	@$100/mt	@$265/mt
Corn	$88.4 Mill.	$234.2 Mill.
Soybeans	$20.8 Mill.	55.0 Mill.
Dairy	$16.4 Mill.	43.6 Mill.
Wheat	$15.4 Mill.	40.7 Mill.
Total	$200 Mill.	$529.5 Mill.

Carbon Permit Fee Per Farmer

	@$100/mt	@$265/mt
MN	$2297	$6086
ND	$4065	$10,772
SD	$2541	$6,732

Research Challenges for Policies Tied to Carbon Sequestration

- Determine Appropriate Carbon Sequestration Rates for Specific Soil-Tillage Regimes for Crops.
- Determine Equitable Level of Credits for Crops and Tree Plantings.

Transportation: Dairy Bulk Truck

Transportation: Diesel Consumption Rates

- Semi-Trailer 75.6 Ton-Miles/Gal.
- Rail Unit Train 260 Ton-Miles/Gal.
- River Barge 680 Ton-Miles/Gal.

Minnesota Ag.Transportation

- % of Statewide Total Transport Fuel
- Corn 26.6%
- Milk 23.1%
- Soybeans 14.9%
- Sugarbeets 12%
- Spring Wheat 12%

Agricultural Processing

Summary: Minnesota Processors

- Coal

  -Sugarbeets, the most @ 440,000 T./yr
  (.06T. Coal/Ton Sugarbeets)
  (Approx. 1 Ton of Coal/ Acre of SB)

- Natural Gas

  -Dairy Processing 7.3 million Mcf
  -Soybean Processing 4.8 million Mcf
  -Sugarbeet Processing 4.4 million Mcf

Processor Energy (cont,)

- Electricity
  - -Soybeans use 195 Million Kwh
  - -Dairy uses 161 Million Kwh
  - -Wheat Milling uses 125 Million Kwh

Most Affected:

- Processing of Sugarbeets
- Processing of Soybeans, Milk, Wheat, Corn wet-milling
- General Rule: When livestock or microbes do the processing, then less exposure to carbon permit fees. When industrialized processing, then more exposure.

Considering the Agriculture-Energy Policy Nexus

Farm Level: Energy Savings

- **Variable Vacuum Pumps, Milk Coolers**
- **Reduced Tillage, Better Diesels**
- **On-farm energy audits**
- **Improve Accuracy of Nutr. & Manure Applicat.**
- **Retire Older, Gas-Powered Trucks**
- **Computerized Sensors on Grain Dryers**
- **Better Electric Motors Are Available**
- **Buildings-- Insulation, Ventilation Systems**
- **Reduce Irrigation Energy Requirements, (at peaks)**
- **Use High Forage Diets for Ruminants**

Dairy Highlights:

- **High Farm Level Electric Use**
- **Good Opportunities To use Forages**
- **High Transport Charges**
- **Milk Drying Requires More Than Cheese Production**

Produce Energy Crops

- Produce Biodiesel
  - With Soyoil--- Energy Balance of 3.24 to one.
  - Biodiesel Production with mustard oil may emerge.
- Produce Corn Ethanol
  - Energy Balance of 1.34 to one.
  - Ethanol Production from Cellulose is Emerging
- Consider Agro-forestry for carbon sequestration and energy crop with hybrid poplars.

Mustard Crops

- **Mustard rotates w/ wheat, even dry-land wheat**
  - low water & fertilizer required
  - suitable throughout the US w/ site specific breeding trials
  - broad-leaf crop with high biomass potential
  - power generation or ethanol production
  - large tap root-- breaks up soil pans
  - commercial crop today ~ 14,000 acres/year
  - seed contain 25% to 40% oil
  - oil can be 90% monosaturated--excellent for biodiesel
  - crop provides rotation benefits for soil pests
  - planted and harvested with wheat equipment

Likely Responses; Transportation

- Better Diesels
- Enhanced Use of Rail and Barges
- Value-added Processing Closer to Site of Ag. Production

Likely Responses: Processors

- Wheat Millers-- Current Use of Off-Peak
  - Rahr Malting wants to use biomass.
- Soybean Crushers--- Use Off-Peak , Moving to Co-Generation
- Sugarbeets--Efforts to Reduce Coal Use
- Natural Gas is Attractive With Lower Emissions for Many Processors
- Ethanol Production from Potato Wastes

Keep Your Eye on This Issue:
Expect Exciting Times with Energy Prices and Farm/Environmental Policy Until Cheap Fuel Cells Arrive in 15-20 years.

Further Interest in Topic?

- **Contact me:**

dtiffany@dept.agecon.umn.edu
(612) 625-6715