Integration of Animal Agriculture with the Bioeconomy

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Coproduct Feeds

Dry Grind Plants

1 bushel corn
2.8 gal ethanol
16 to 17 lbs DGS (DM)

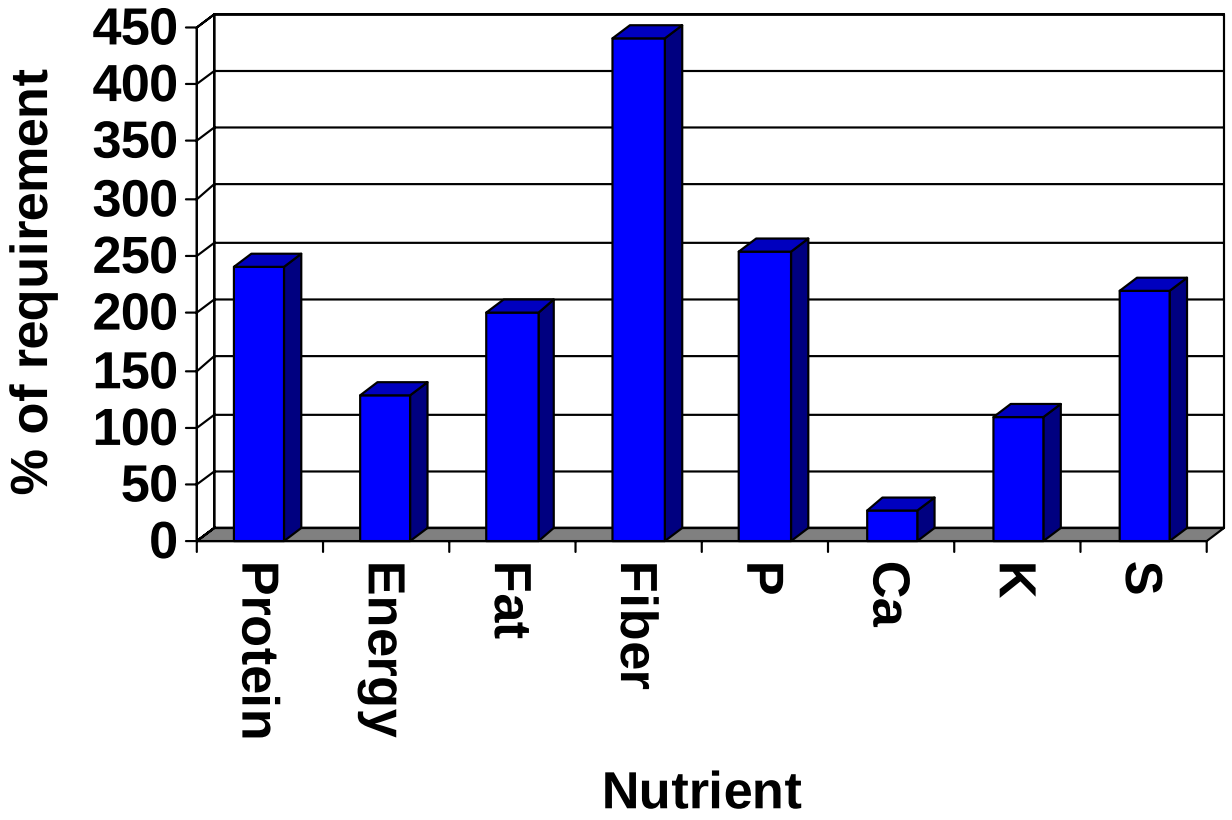
Distillers grains - DG
- Wet – 30 to 35% DM
- Dry – 90 to 92% DM

Condensed distillers solubles - CDS
- Wet – 30 to 32% DM (variable)
- Dry – 90 to 92% DM (not readily available)

Distillers grains with solubles – DGS
- Wet – 30 to 50% DM
- Dry – 90 to 92% DM

Composition of Distillers Grains with Solubles as a Percentage of Required Nutrients

700 lb Finishing Steers



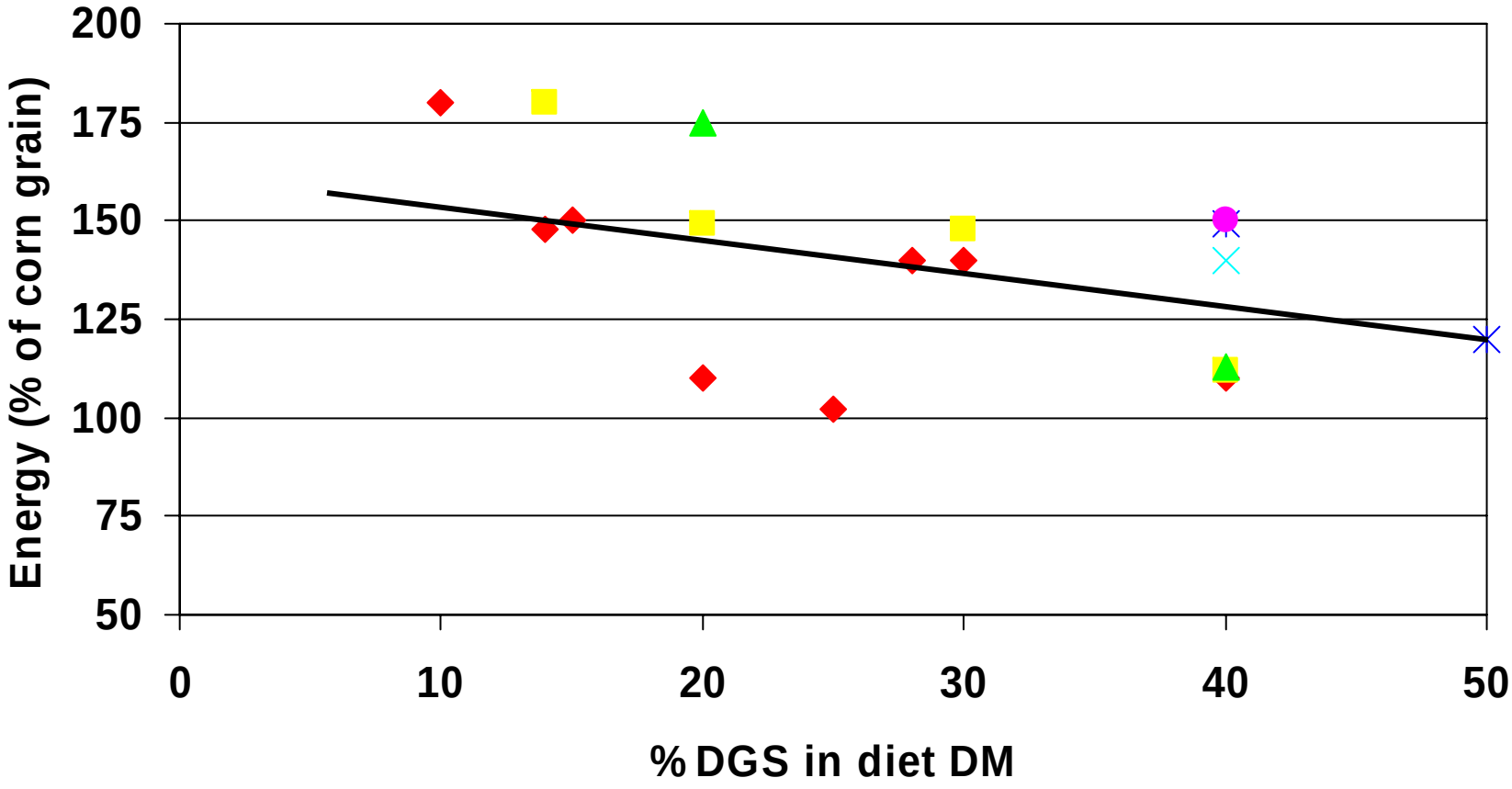
Response of Beef Cattle to Wet DGS

Three Feeding Trials – Iowa State University

	% Ration DM as wet DGS			
	0*	16*	28	40*
Feed, lbs DM/d	19.7	20.0	19.2	18.8
Gain, lbs/d	3.13	3.57	3.45	3.27
Feed/gain	6.32	5.65	5.64	5.70
Tenderness**	5.8		5.6	6.1
Flavor**	5.8		5.6	5.8

*72 cattle per group **1 is low, 8 is high

Energy of DGS When Replacing Corn in Cattle Finishing Diets



Iowa State University, University of Nebraska, University of Illinois

Recommendations for Feeding DGS
Beef Cattle

Growing and Finishing Cattle

Dry DGS (90% dry matter)

Feed to supply protein requirement

- < 20% of ration dry matter

Wet DGS (30% dry matter)

1. Feed < 20% to supply protein and energy
2. Most feeders comfortable with feeding wet DGS at < 25% of ration dry matter
   - Greatest value at 15 to 20% of ration dry matter
   - Can feed up to 40% of ration dry matter to beef cattle
   - Overfeeding protein and phosphorus

Beef cows and backgrounding calves

Feed quantity to supply protein, energy and phosphorus

Poor quality hay, crop residues, stockpiled forages

Recommendations for Feeding Dry DGS
Swine

Starter

- Up to 25% of diet as DDGS
  - Pigs weigh >7 kg and formulate on digestible amino acids

Grow-Finish

- Up to 10% of diet as DDGS
  - Formulate on total amino acid basis
  - Soft pork might result when more than 20% is fed

Gestating and Lactating Sows

- Diets containing 50% DDGS will support reproduction
- Diets containing 20% DDGS will support lactation and baby pig growth

<u>Attributes as feed for swine</u>

- Increased availability of phosphorus
- Plant to plant variability – Amino acids
- High inclusion rates might reduce feed intake

What is DGS?

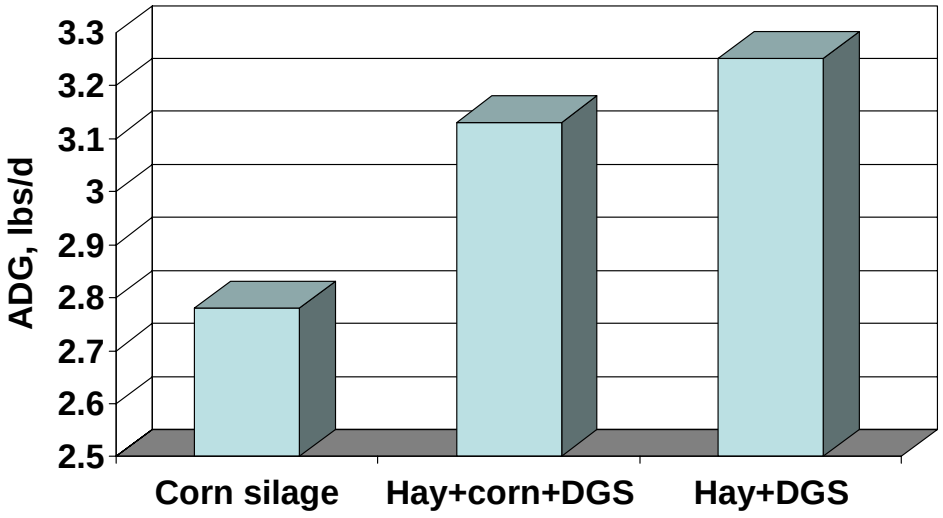
Distillers Grains with Solubles

Behaves more like roughages than grain in the rumen
Energy value for cattle is similar to corn

Allows nutritionists to think differently with respect to potential opportunities

Not a waste and not something to get rid of at an economical price

What are the opportunities for Iowa agriculture?



Beef Steers

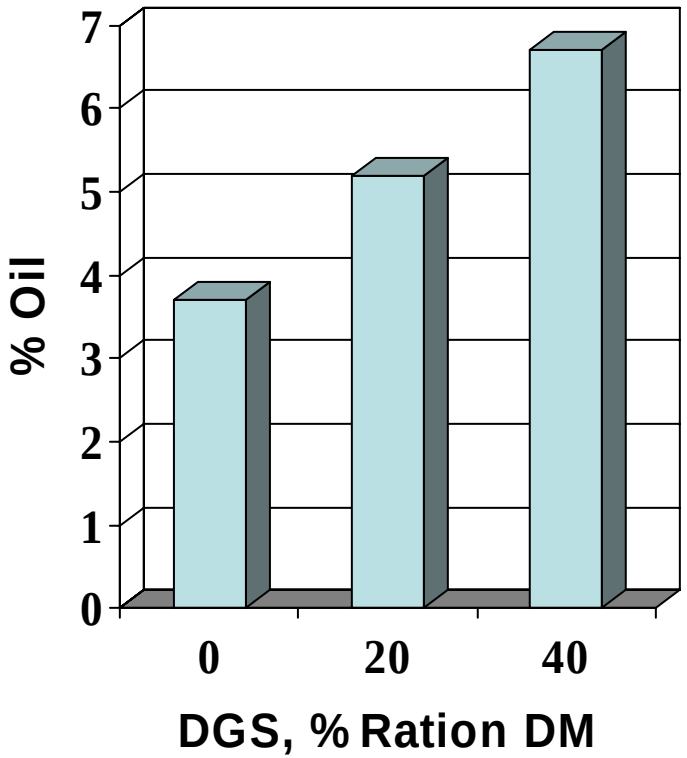
Fed: 60% Wet DGS and 40% Corn Stover

Fed 210 days

Start weight, lbs	690
Daily gain, lbs	2.79
Daily feed DM, lbs	20.0
Feed/gain	7.18
Carcass weight, lbs	738
Percent USDA Choice	31
Yield grade	2.61

Potential for Improving DGS as Feed for Cattle

- Corn gluten feed: 3 % oil
  - No effect in corn-based ration
- Wet distillers grains with solubles
  - Distillers grains: 10% oil
  - Distillers solubles: 15% oil
- Distillers grains would be improved as feed for cattle if some of oil removed
- Could feed more DGS to cattle



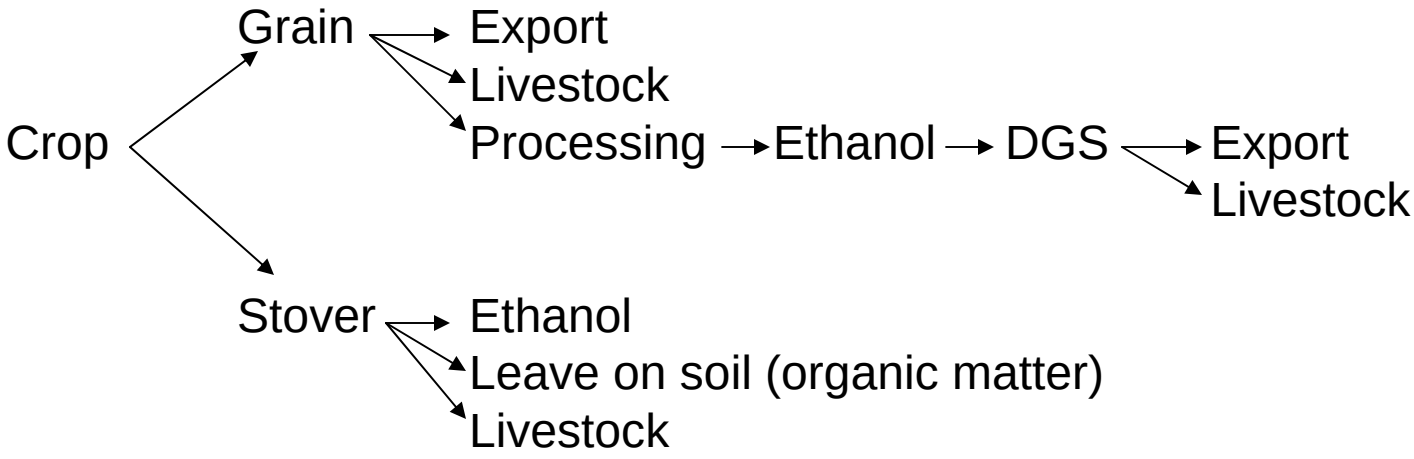
Use of Corn Crop for Production of Energy

Agriculture models

1. Cycle (Closed loop): Recycle nonrenewable resources

2. Linear (Open end): Use resources to make things to sell

Choices:



Iowa Ethanol

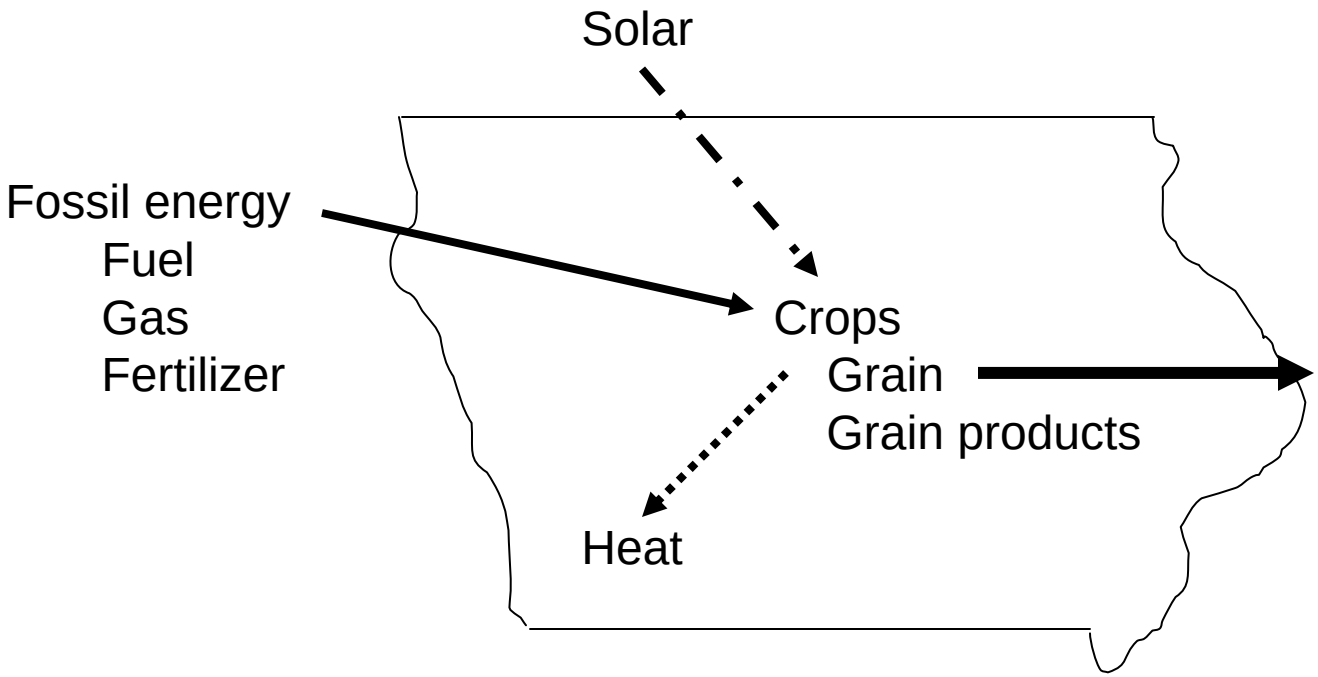
An Agricultural Catastrophe or an Opportunity for Change?

Why it might be a catastrophe in Iowa

Increase use of corn by processors

- Increase acreage of continuous corn
- Decrease use by other sectors
  - Decrease livestock (food) production

Agriculture Energy Balance in a Monoculture

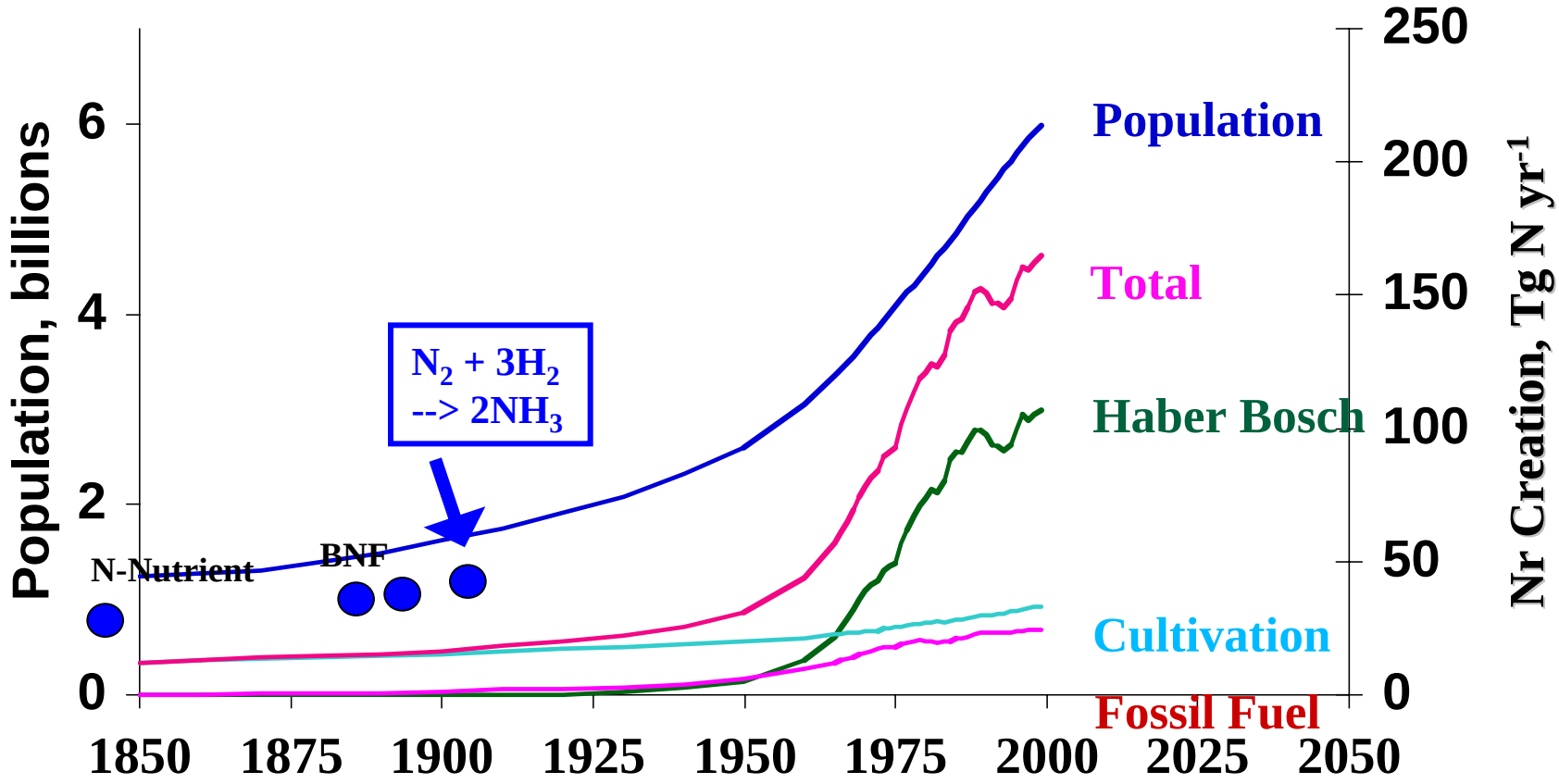


Unit trains to haul corn and DGS out of IA

Exported energy is greater than imported fossil energy

- Low ecological sustainability
- System was economically sustainable when cost of fossil energy was low
- As energy costs rise, emphasis should be on reducing input of fossil energy in an economically sustainable system

Timeline of Global Reactive N Creation by Human Activity 1850 to 2000



Galloway et al., 2003

Iowa Ethanol

An Agricultural Catastrophe or an Opportunity for Change?

Why it is an opportunity

Change the agricultural system

- Improve efficiency of energy use

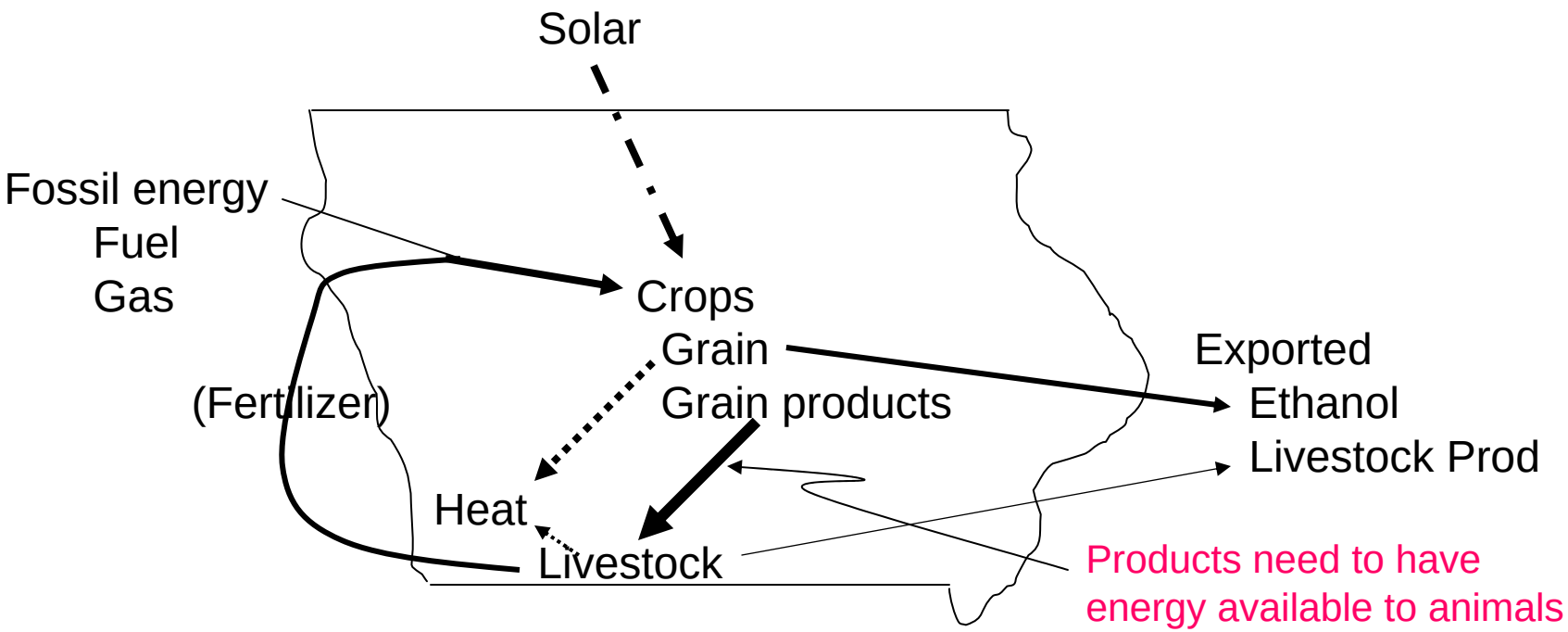
  Reduce total energy input into producing corn

- Be more conservative of use of a major Iowa resource

  Soils and natural rainfall

Agriculture Energy Balance in a Nutrient Recycling System

Recycle Model



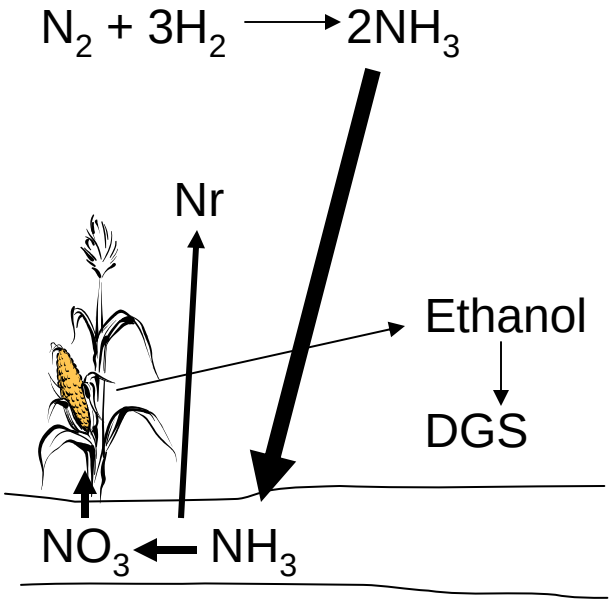
Exported energy is greater than imported fossil energy

- System requires less input of fossil energy
- Much of the economic activity stays in Iowa
- System is more ecologically sustainable

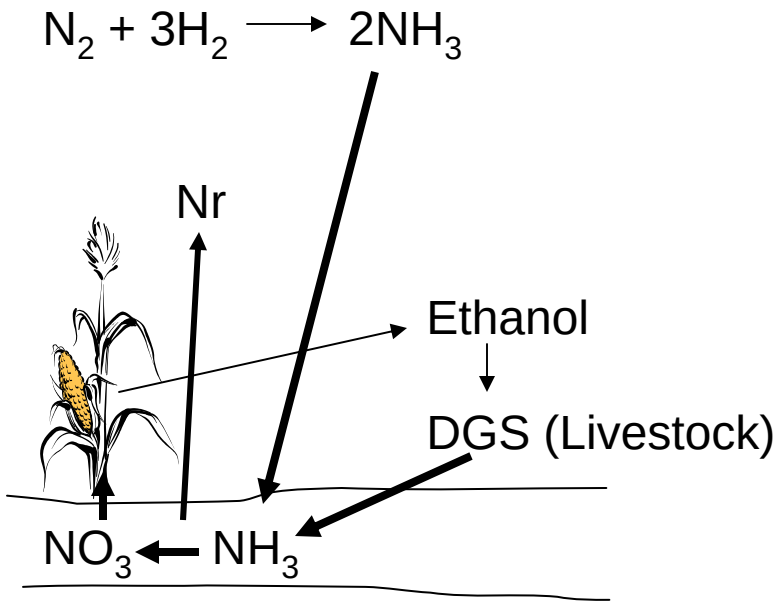
  Greater diversification of crops

Nitrogen Flows in Alternate Systems

<u>DGS Exported</u>

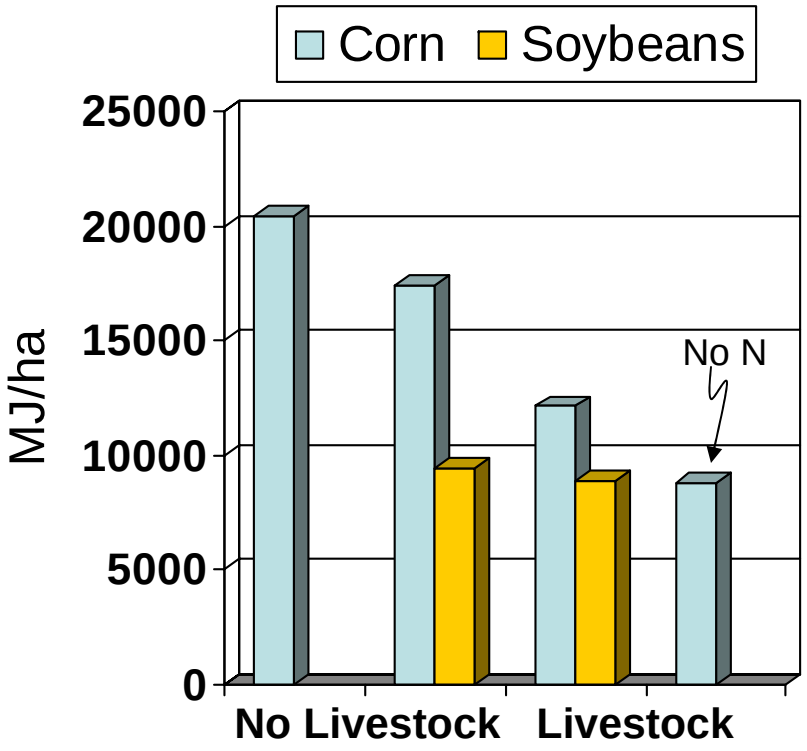


<u>DGS Fed to Livestocdk</u>
(Nutrients Recycled)



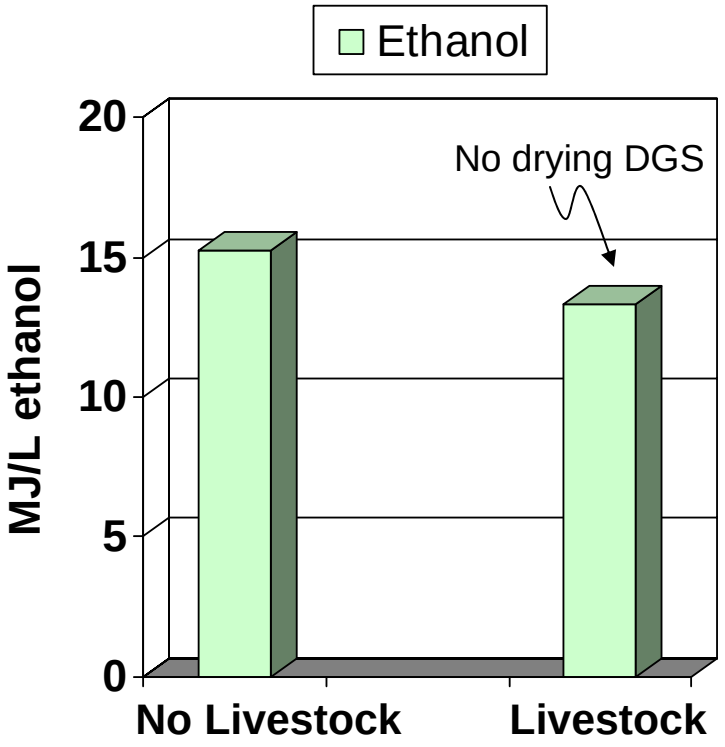
N, lbs/a	C:C	C:S	C:S+LiveStock	C:S+LiveStock
Fertilizer Input	151	105	50	0
In grain	125	125	125	125
Back to farm	0	0	125	125
Manure	0	0	55	105

Effect of Livestock on Energy Inputs for Crop and Ethanol Production



Energy input at the farm

Corn:175 bu/a SB: 45 bu/a



Energy input at ethanol plant

2.75 gal/bu

Feed all DGS in Iowa

Is it Realistic to Recycle all Minerals Back to the Land?

1. If all DGS fed to finishing cattle
   Projected to produce 5.12 mil ton DGS
   Would need 5.0 mil fed cattle (current number 1.76 mil)

2. Use number of swine, dairy and poultry projected by McVey, Baumel and Wisner (2005):
   - Feed swine 10% of diet (30.1 million)
   - Feed poultry 5% of diet (72.2 million layers, 10.4 million turkeys)
   - Lactating dairy cows 20% of diet (214 thousand)
3. Increase beef cows to 2 mil head (968,000 current) and feed 20% of diet as DGS for 90 days

All of above would use 1.91 mil ton DGS

Need 3.1 mil finishing cattle to use remainder (3.21 mil ton)
Over 4 mil/year cattle fed in Iowa during 1968 – 1972 period

Increase Number of Cattle Fed in Iowa

1. Increase size of current feedlots
   - 1997: 282 feedlots >1000 head (691,000 head)
   - 2002: 332 feedlots >1000 head (811,000 head)

2. Increase number of feedlots
   - 1997: 13,372 feedlots (1.7 million)
   - 2002: 10,386 feedlots (1.8 million)

   <100 head: 10,496 to 7,318 (283,000 to 214,000)
   100 to 999: 2,594 to 2,736 (706,000 to 781,000)

   a) Increase number of conventional cattle feeders
      Iowa investment
      Outside investment
   b) Develop cattle feeding companies
      Investment opportunities
   c) Develop less intensive programs attractive to farmers who work off the farm

Potential for Cattle Production in Iowa

Consider no-grain rations to feed cattle

- Feed hay + DGS or corn stover + DGS
- Safe no-starch diets require less bunk management
- Increase quantity of DGS that can be fed to 50% or more of diet DM
- Reduce competition for corn grain

Assumptions:

- Corn yield: 175 bu/a
- Cattle performance: 600 to 1300 lbs, 2.42 lbs/d, Feed/gain 7.30
- 290 day feeding period 1.12 steers/a (50% DGS)
- Grain used for ethanol, but all DGS returned to farm

5.12 million ton supply of DGS

- 4 million fed cattle if all fed to cattle
- 2.5 million fed cattle if 1.91 million tons fed to other species

Conclusions

Integrating corn production with ethanol and livestock:

- Improve balance of soil nutrients within the state (or on farm) and reduce energy imported into Iowa for corn production (4.2 to 6.6 million barrels of oil/year)
- Produce food and fuel
- Reduce the quantity of nitrogen fixed by Haber Bosh Process and imported into Iowa (330 to 630 thousand tons/year)
- Increase economic activity in Iowa