Manure of the Future

Mark Jenner, PhD

Manure Visionary

Biomass Rules, LLC
Economics / Regulations / Infrastructure

Manure Entrepreneurs

May 22, 2008

Manure of the Future…

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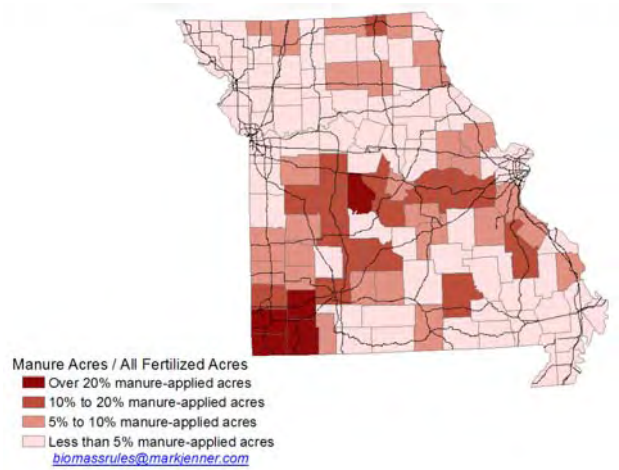
- Will require a greater knowledge of manure quality ***as a feedstock*** than ever before.
- Will utilize complementary, nested technologies and generate ***multiple outputs.***
- Will require a more sophisticated **infrastructure**.

Current Manure Utilization

2002, USDA Census of Ag



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What is the Quality of Your Manure?

If you want to *sell* your manure, you had better know the *quality* of it!

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Manure Must Be Understood

- **Feces and urine as voided.**
- Feces, urine, other excrement, and bedding produced by livestock that has not been composted.
- ***Manure***, bedding, compost and raw materials or other materials commingled with manure or set aside for disposal.
- **Unused corn and soybeans.**

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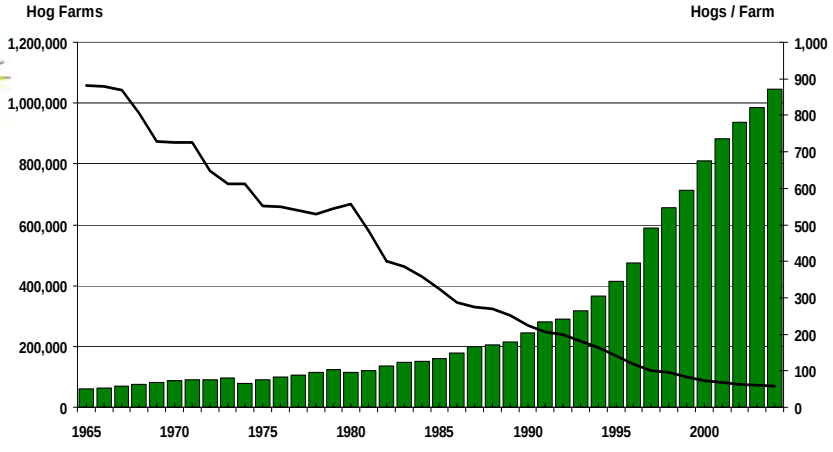
Manure Today is Different Than Manure of 30 Years



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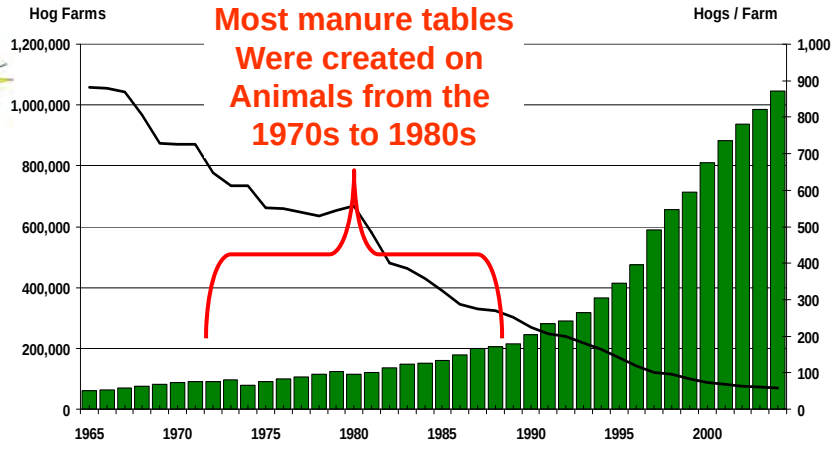
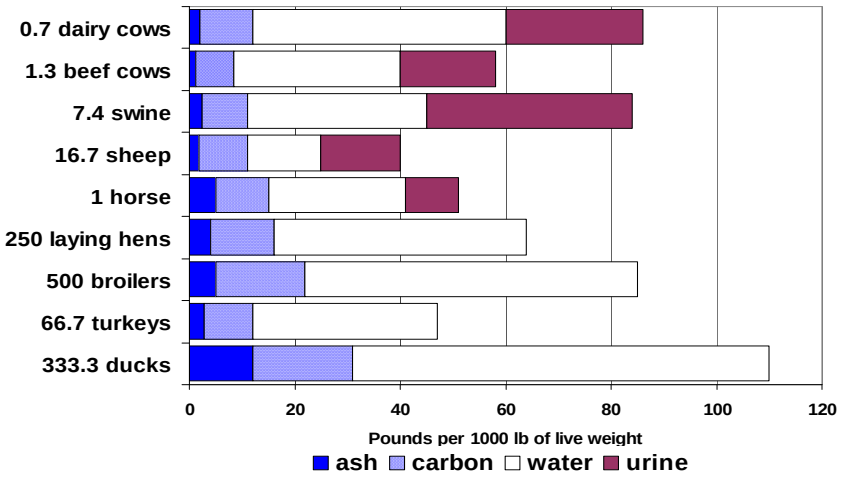
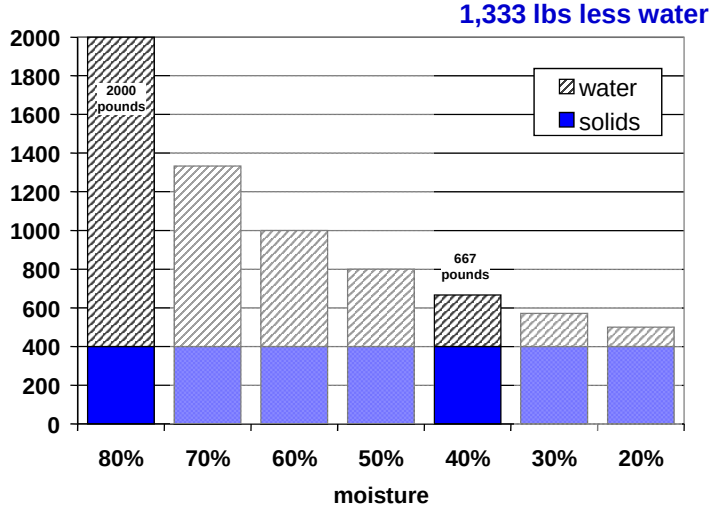


Manure Quality Varies



Water Content Matters

400 lbs solids @ 80% moisture = 2,000 lbs
400 lbs solids @ 40% moisture = 667 lbs
1,333 lbs less water



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Is Manure an Environmental Benefit or Liability?

- CERCLA air quality emissions limit is 100 lbs., NH3 per day. 365-days of that emission is 18 tons/year of NH3.
- A CAFO Rule success has been that it is easier to managing P in the feed.
- Carbon Credits have changed the way we look at CH4. Is CH4 an environmental evil or economic benefit?

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Efficiency Is Increasing

- **Increased rate of gain** from better genetics and better feed formulations
- **Manure quality can be lower**. Smithfield methanol project did not work because real manure was less 'potent' than the tabled manure estimates.
- **Manure can have higher values.**
- ***Before*** capital investments are made, **establish the quality of the manure.**

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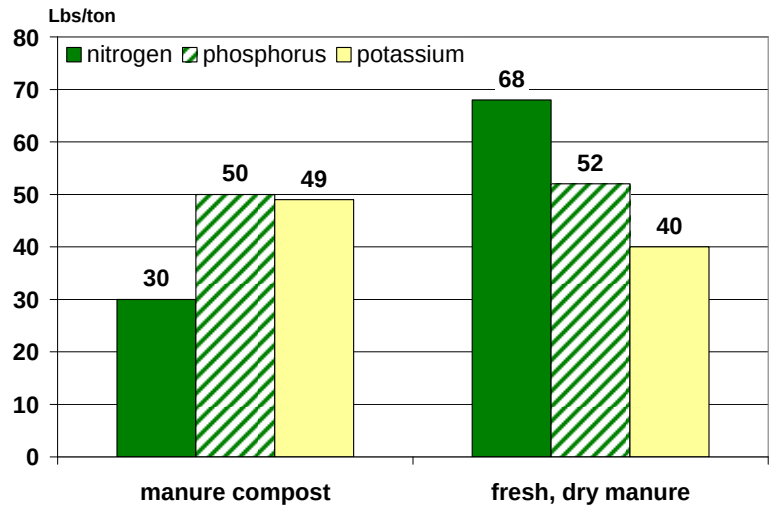
High Quality Manure



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High Quality Manure

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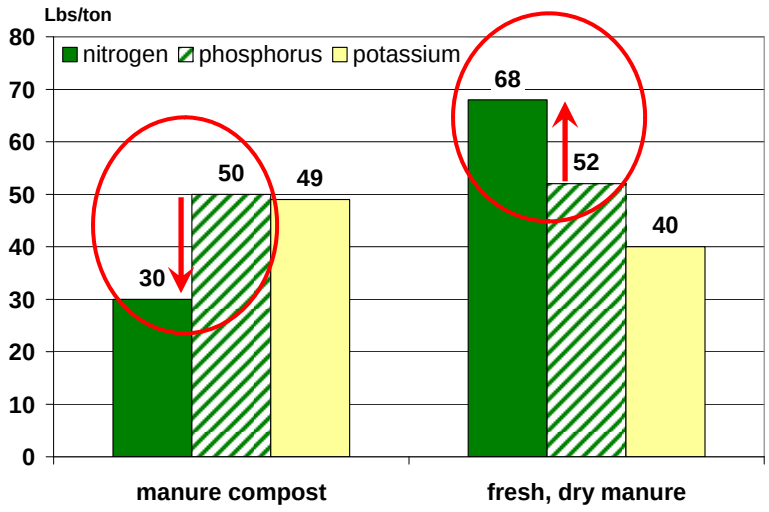

Capitalize on System Benefits

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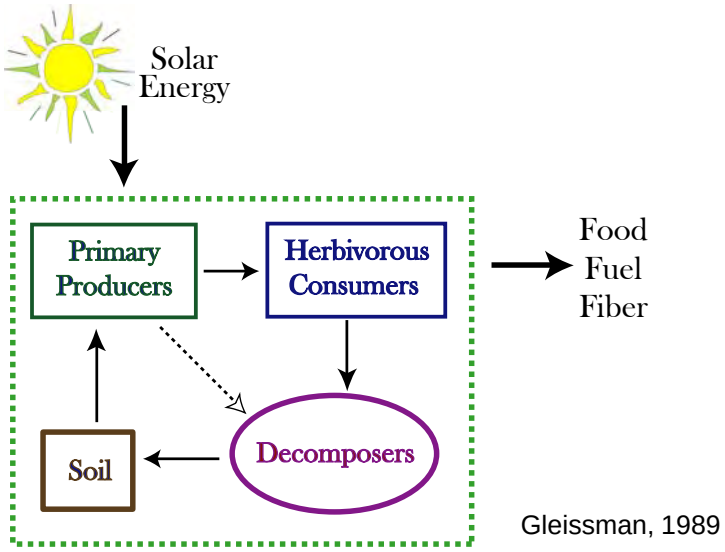
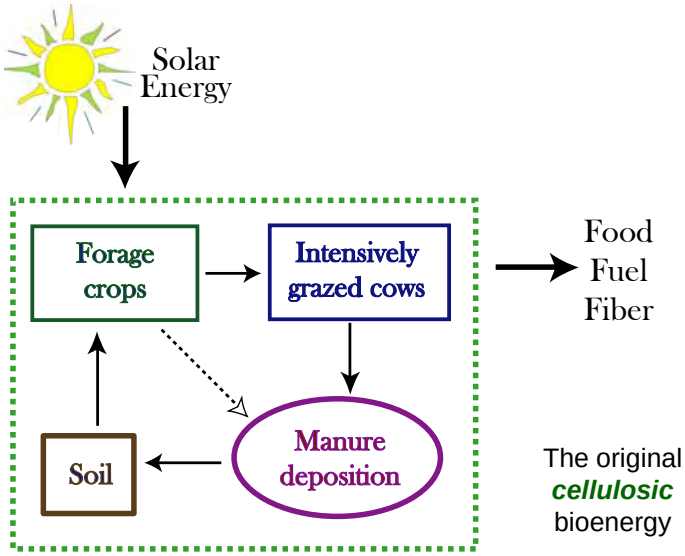
- Energy flows through the system. Capture that waste heat for other uses before it leaves.
- Recycle nutrients and water.
- Bring in outside materials to optimize the technology.
- Generate as many marketable products as possible.

The Production Ecosystem



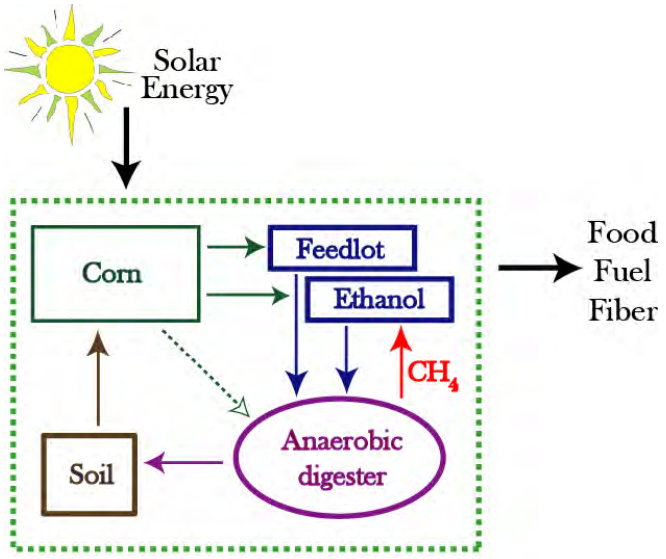
Gleissman, 1989

Intensive Grazing System

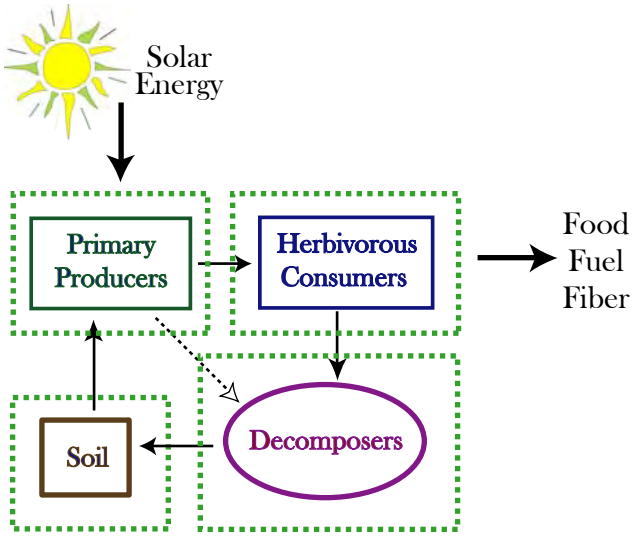


The original ***cellulosic*** bioenergy

E3 Biofuels (currently closed)



The Ecosystem w/ Markets



Consider Other Feedstocks

- Are there other materials that will aid in composting? Anaerobic digestion?
- Dairy wash water, mortalities, yard waste food processing wastes, restaurant left-overs, used oils, grease trap waste?
- What kind of regulatory/legal complications arise from mixing materials?
- Is there 'tipping' revenue available?

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Do Not Rely On Single Market

- 2007, USDA NRCS report: digester costs from 7 to 29 cents/kWh installed.
- Revenue from power sales was reported between to be from 2 to 6 cents/kWh.
- Other revenue sources can be from cost offsets, sale of green power, digester solids, and carbon credits.

The Sum of Benefits >> Sum of Costs.

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Target All Available Markets

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- Fertilizer (N, P, K)
- Organic soil amendment (C)
- Compost
- Green power
- Carbon credits
- Building materials
- Other fiber markets
- Heat offsets
- Power offsets
- Local industrial demand
- Remediation Mkts
- Fish food
- Algae production
- Activated charcoal?

Infrastructure Development Adds Benefits/Costs

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- Feedstock supply
- Technology maintenance
- Market development and service
- Market regulatory support
- Environmental regulatory compliance
- Infrastructure development takes time

The Early US Digester Industry

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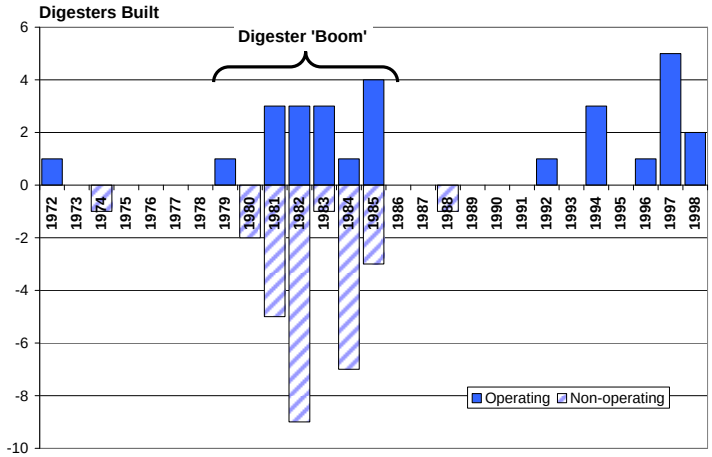

How Much Manure does it Take to Light a Light Bulb?

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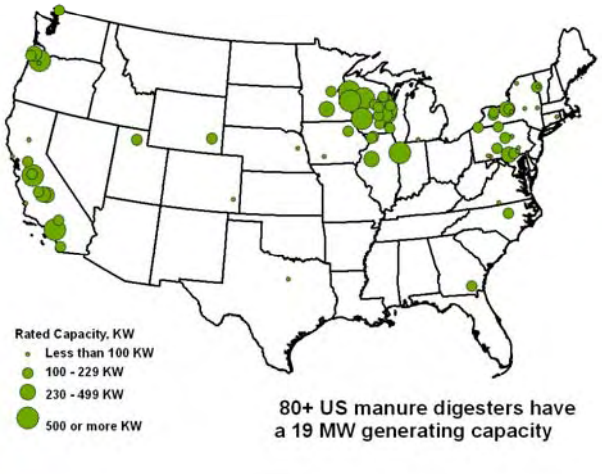

Serious Manure Power

- **Benson, MN – 55 MW from turkey manure**
- **Stephenville, TX – Microgy producing natural gas from manure of 10,000 cows and 8 million gallons of digester capacity**
- **E3 Biofuels, Mead, NE – powering a 25 million gallon ethanol plant on manure from 28,000 cattle**
- Panda Energy fueling a 115 million gallon ethanol plant on **1 billion pounds** of manure
- Hull, IA – Bison Renewable Energy, natural gas from **11 million gallon** methane digester.

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Infrastructure Development

- What energy form is most appropriate?
  - ***Electricity (challenges with transmission and interconnectivity)***
  - ***Sale of biogas direct to manufacturer***
- Regulatory costs must be smaller than the benefits of the energy.
  - ***Feedstock must be an appropriate choice (no serious risks)***
  - ***Cross-jurisdictional agencies must complement energy production and environmental goals.***

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Address Specific Market

compost value market expects performance

	Industry Quality	State Lab Quality
pH	✓	✓
Soluble Salts	✓	✓
N-P-K	✓	✓
Organic Matter	✓	✓
Moisture %	✓	✓
Particle Size	✓	
Maturity	✓	
Stability	✓	
Inerts	✓	
Trace Metals	✓	✓
Weed Seed/Pathogens	✓	
Cost of Test	$300	$40

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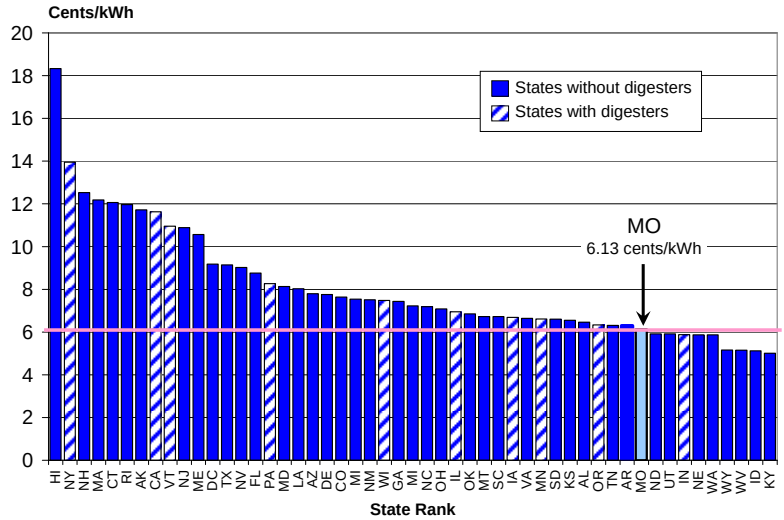
Are High Prices Good?

State Electricity Prices, 2005



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Take Home Messages

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- Know the ***quality*** of your manure.
- Look at how it can be nested with other technologies to produce ***multiple outputs***
- Work together to advance a new information, distribution, and market **infrastructure**.

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+ renewable market development
+ biomass inventory/utilization
+ streamlining regulations
+ land use / demographics

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