

Creating Renewable Energy From Livestock Waste: Overcoming Barriers to Adoption

Power-Gen Renewable Energy and Fuels Conference
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Agenda and Goals for Today

- The opportunity for livestock waste
- Barriers to adoption
- Conclusion

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Opportunity for Livestock Operations

- Livestock operations have considerable energy generating potential
 - Biomass is low-cost
 - Collected in one spot
 - Consistently supplied
 - Proven technology to harvest the energy
 - Economics can be greatly enhanced by processing other organic materials



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Livestock Sector

- Economics drives towards CAFO's
 - Large farms = large piles
 - Increasing pressure to treat
 - Increasing regulation
 - Waste is one limiting factor in drive to larger systems

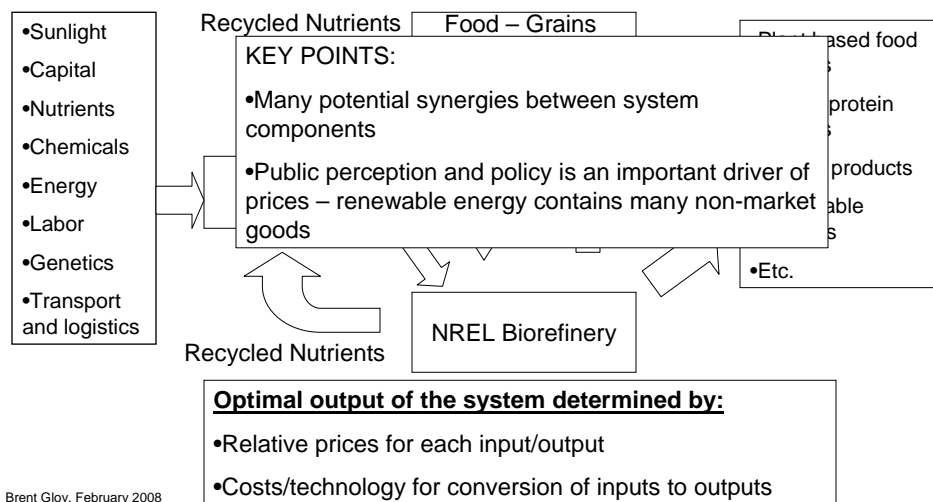


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Understanding the Agricultural System

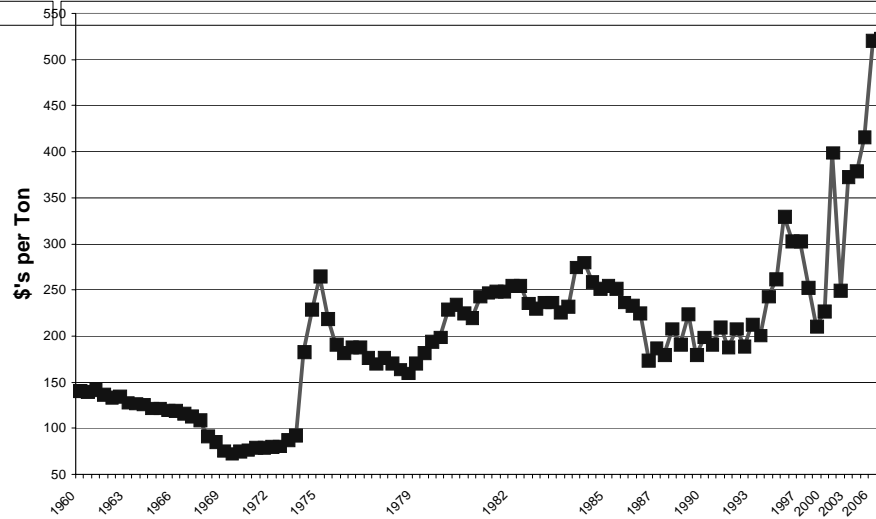


Consider Manure

- On most farms manure is currently treated as a waste with a negative economic value
- This may soon change
 - Rising energy prices
 - Rising fertilizer prices
 - Improved technology for nutrient and energy recovery
 - Increasing scale of livestock operations
 - Increasing negative public attitudes toward livestock wastes – air quality and nutrient capture

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Anhydrous Ammonia Prices 1960-2007



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Source: ERS, USDA

The Potential Value of Manure

WARNING: SUBSTANTIAL COSTS ARE REQUIRED TO COLLECT THESE REVENUES

- A 10,000 cow dairy operation produces
 - 259,077 tons of waste per year
 - 35,529 tons of dry waste per year
 - 1,699 tons of N = \$1.02M @ \$600/ton
 - 287 tons of P = \$115k @ \$400/ton
 - 442 tons of K = \$115k @ \$260/ton
 - 176k MMBTU's of renewable energy = \$1.4M @ \$8/MMBTU

Total Potential Revenue = \$2.7 M

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Anaerobic Digestion

- Works with wet material
- Well known and understood
- Biogas = 55-65% methane + impurities
- Various styles and approaches to technology

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Anaerobic Digestion of Livestock Waste

- Breakdown of organic material in an oxygen free environment (air tight tank)
- Designed to handle high moisture products
- Methanogenic bacteria process organic materials to produce biogas (60-70% methane)
- Gas can be cleaned to be equivalent to natural gas
- Reduces odors in livestock waste
- Simple process creates a compost type fertilizer product

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Anaerobic Digester



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Room for More AD in the US?

- Digesters: 97 operating and 80 in planning in the US (2006 AgStar)
 - Germany today operates 1,900+ farm biogas plants
- Potential sites: 6,904 dairies and hog sites that are legitimate candidates (EPA)
 - Would result in a 66% methane reduction for these sectors

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Keys to Economical Biogas Systems

1. Scale appropriate for
 - Professional management
 - Modern technology
 - Competitive energy sale
2. Attractive energy sale option
 - Electricity or other use for gas
 - Willing (enthusiastic) buyer
 - Able to monetize environmental attributes
3. Ability to add wastes beyond manure

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Barriers to Overcome

1. Site specific approach and technology
 - Manure has low energy density
 - Good for co-digestion
 - Limits number of economical sites
 - Many potential contaminants
 - Large number of farmers to work with
2. Different energy markets
3. Markets for positive externalities

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Low Energy Density of Feedstock

Table 2. Energy Content and Value of Potential AD Feedstocks^a

Component	Value
Pounds of manure per ton	2,000
Volatile solids content (%)	11%
Solid conversion to biogas (%)	30%
Cubic feet of biogas per lb of volatile solid converted	20
BTU's per cubic foot of biogas	625
BTU's per ton	850,000
Value per MMBTU (\$'s)	7
Value per ton of waste (\$'s/ton)	5.95

^a Values derived from various sources including: Krich, et.al., Martin and Roos.

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Energy Markets

Market	Current Status	Potential
On-farm use	Well established in practice	Limited to energy used by individual farms.
Industrial process	Biogas substituted for natural gas by nearby industrial user. Few applications currently in practice.	Very limited/site specific.
Electrical	Sold to electrical grid. Commonly used in practice.	Large potential market. Each sale must be negotiated individually.
Natural gas transmission network	Biogas must be cleaned and compressed. Only a few applications in the United States.	Large potential market. Standards for biogas quality required are not well developed. Must negotiate with each utility.
Transport fuel	Biogas must be cleaned and compressed. Some use in Europe	Large potential market. Many technical and practical hurdles to adoption.

Environmental Attributes

- The size and outlook of the opportunity is dependent upon the extent to which consumers and the government remain willing to support the environmental benefits of biogas
 - Produces renewable energy
 - Environmental solutions

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Approaches to Barriers

- Currently there are limited incentives with a mix of local, state, and, federal policies
 - Construction subsidies – high cost (impact ?)
 - Loan guarantees – lower cost and high impact
 - Various state and local policies on net metering
 - Some utilities providing variable rate incentives
 - Voluntary market for environmental attributes

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The Need

- Coherent policy
 - Variable rate incentives for electricity or gas
 - Mandate for renewable electricity – must allow flexibility
 - Clear environmental policy
 - National standards for biogas quality
 - Incentives for new technology development
 - Incentives for new markets (compressed biomethane)
 - Need for industry organization/representation
 - Research on prospects for using other substrates/crops

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Questions

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