

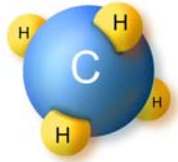


Advancing Energy Independence with Environmental Benefit: *Livestock Manure Digesters*

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AgSTAR
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Why advance manure digester systems?

- Assist US farmers in:
 - developing opportunities for **next-generation** interest in farming;
 - Grow markets for energy, renewable energy credits, GHG credits, value-added products, and nutrients
 - protecting and **conserving natural resources** and **reducing greenhouse gas** emissions;
 - expanding opportunities for **rural economic development** and **diversified revenues**; and
 - producing **renewable energy** and ‘**green**’ products.



Methane

- Methane is the second most important GHG
 - 100-year Global Warming Potential = 25
 - Lifetime = 12 years
 - To avoid near term impacts, methane capture is one of the most important approaches
 - **Most important short-lived forcer: methane emissions currently contribute to 1/3 of anthropogenic forcing**
- Great source of energy
 - Mitigate greenhouse gasses with potential for ROI
 - Many opportunities to recover (livestock, energy, and waste sectors)
- Concentration of methane in the atmosphere has increased by 150% in the last 260 years
- Anthropogenic methane emissions are expected to rise 23% by 2020

US Livestock Industry

- Animal Numbers*
 - Swine: 68 million
 - Dairy cows: 9 million
 - Poultry: 2 billion (broilers, layers, turkeys)
- Total Manure Excreted**
 - Dairy cows: 246 million tons/year
 - Swine: 97 million tons/year
 - Poultry: more than 88 million tons/year
 - **More than 430 million tons/year**

* Based on USDA Census of Agriculture (2007)

** Based on USDA NRCS Ag Waste Management Handbook (2008)

Digester Market Opportunity*

- Candidate Dairy/Hog Farms
 - ~4,000,000 dairy cows on 2,600 farms
 - Manure: 106 million tons/year
 - ~48,000,000 hogs on 5,500 farms
 - Manure: 68 million tons/year
- Energy Potential
 - 13,000,000 MWh/yr OR 150 billion cubic feet methane per year
 - Enough electricity to power 870,000 households
 - Enough methane to heat 3 million households
- Does not include co-digestion!

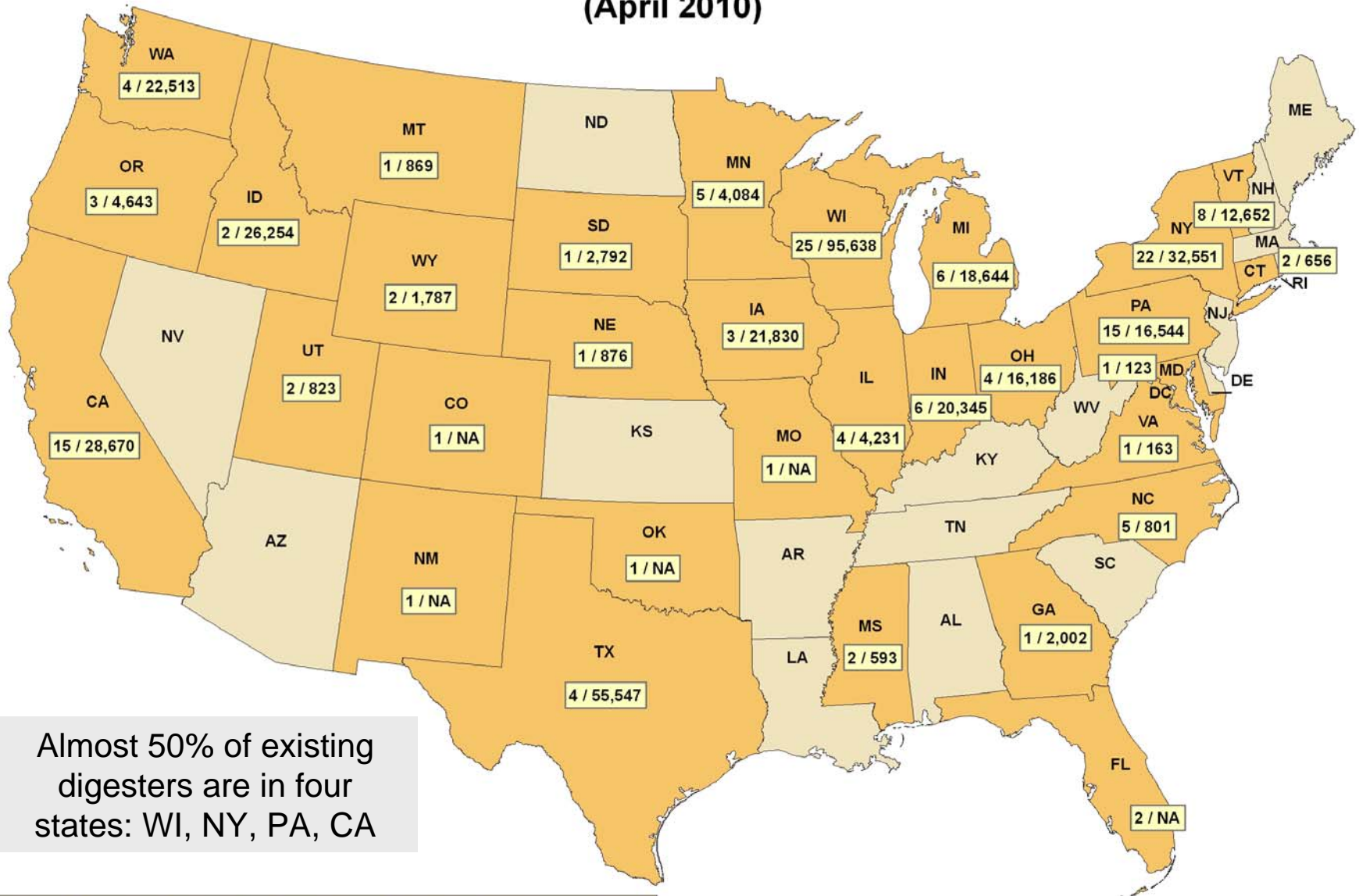
* Based on EPA AgSTAR Market Opportunities Report (2010)

Top 10 States for Electricity Generating Potential from Manure Biogas Recovery Systems*

State	Number of Candidate Farms	Methane Emissions Reductions (1,000 Tons)	Methane Production Potential (billion ft ³ /year)	Energy Production Potential (1000 MMBtu/year)	Electricity Generation Potential (1,000 MWh/year)
SWINE FARMS					
Iowa	1,997	301	21.5	19,818	1,829
North Carolina	939	203	13.2	12,145	1,121
Minnesota	707	63	7.3	6,726	621
Illinois	350	39	4.3	3,936	363
Missouri	154	34	3.5	3,265	301
Indiana	296	31	3.5	3,208	296
Oklahoma	56	51	3.4	3,164	292
Nebraska	177	27	3.2	2,942	272
Kansas	80	22	2.3	2,161	199
Texas	10	25	1.6	1,516	140
Remaining 40 States	830	109	10.6	9,828	907
Subtotal	5,596	905	74.4	68,710	6,342
DAIRY FARMS					
California	889	341	27.9	25,729	2,375
Idaho	203	99	8.9	8,257	762
New Mexico	110	64	5.3	4,930	455
Texas	155	66	5.0	4,644	429
Wisconsin	251	41	4.5	4,178	386
Washington	125	35	3.4	3,183	294
Arizona	54	44	3.1	2,851	263
Michigan	107	26	2.9	2,661	246
New York	111	18	2.1	1,915	177
Colorado	54	22	2.0	1,889	174
Remaining 40 States	588	152	14.6	13,473	1,243
Subtotal	2,645	908	79.9	73,709	6,803
U.S. Total	8,241	1,813	154	142,419	13,144

* Preliminary assessment based on the 2007 Census of Agriculture. Subtotals and totals may not add due to rounding. A full report will be posted on the AgSTAR website, www.epa.gov/agstar later this year.

Operating Manure Digesters (April 2010)

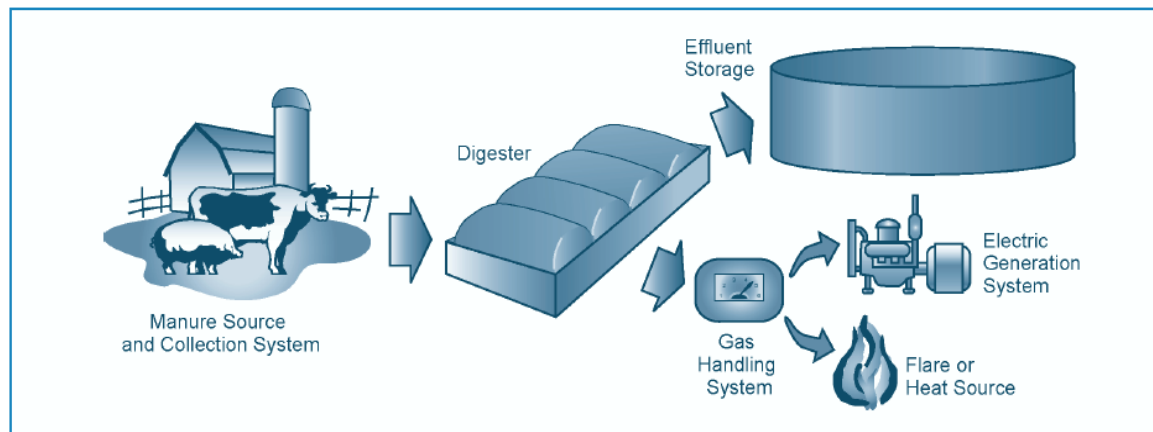


Almost 50% of existing digesters are in four states: WI, NY, PA, CA

Number of Operating Projects / Estimated Energy Production (MWh/yr equivalent)
 Total Operating Projects: 151
 Total Estimated Energy Production: 392,000 MWh/yr equivalent

What are Anaerobic Digesters?

- Anaerobic digestion is a biological treatment and stabilization process that consumes organic matter in an oxygen-free environment.
- Anaerobic Digester “**Systems**”:
 - collect and combust off-gases from liquid, slurry, and semi-solid waste
 - separate manure treatment from storage functions, which can result in lower initial installation costs for new or expanding farms.
 - Could include nutrient treatment component



Digesters Around the World

Mixed Tank (CSTR)



Anaerobic Sludge Blanket
Attached Media



Plug Flow



Why Anaerobic Digesters?

- **Air Quality Benefits**

- Control odors from storage and field application
- Reduce greenhouse gas emissions (methane)
- Controls other emissions (H₂S, ammonia, VOCs)
- Offset fossil fuel emissions from transportation (bedding, fertilizer)

- **Water Quality Benefits**

- Stabilize manure organics (reduce BOD/COD)
- Significantly reduce pathogens
- Reduce rainwater intrusion
- Allow for appropriate fertilizer application timing
- Alternate disposal option for organic waste streams

- **Financial Benefits**

- Waste management system with potential for return on investment
 - Quality fertilizer (nutrients)
 - Energy revenues
 - Carbon credits
 - Fiber (primarily dairy manure)
 - Tipping fees for co-digestion

- **Digesters provide biogas energy**

Parameter	Impact
Odor	Substantial reduction
Greenhouse gas emissions	<p>Methane—substantial reduction (19,300 tons per yr on a carbon dioxide equivalent basis)</p> <p>Carbon dioxide—669 tons per yr associated with the reduction in fossil fuel use to generate electricity</p> <p>Nitrous oxide—No increase or decrease from the baseline of 0</p>
Ammonia emissions	No significant reduction
Potential water quality impacts	<p>Oxygen demand—substantial reduction (~15,600 lb per yr)</p> <p>Indicator organisms and potentially pathogens—significant reduction (Fecal coliforms: ~90%) (Fecal streptococcus: ~75%)</p> <p>Nutrient enrichment—no reduction</p>
Energy production and utilization	<p>Biogas captured—118,503 ft³/day</p> <p>Biogas utilized—76,076 ft³/day</p> <p>Biogas energy produced—82.7x10⁶ Btu/day</p> <p>Biogas energy utilized—53.1 x10⁶ Btu/day</p> <p>Electricity generated—4,172 kWh/day</p>
Economic impact	Significant increase in net farm income (~\$108,000 per year after recovery of capital invested in 6.6 years)

Summary Results:

AN EVALUATION OF A COVERED ANAEROBIC LAGOON FOR FLUSHED DAIRY CATTLE MANURE STABILIZATION AND BIOGAS PRODUCTION

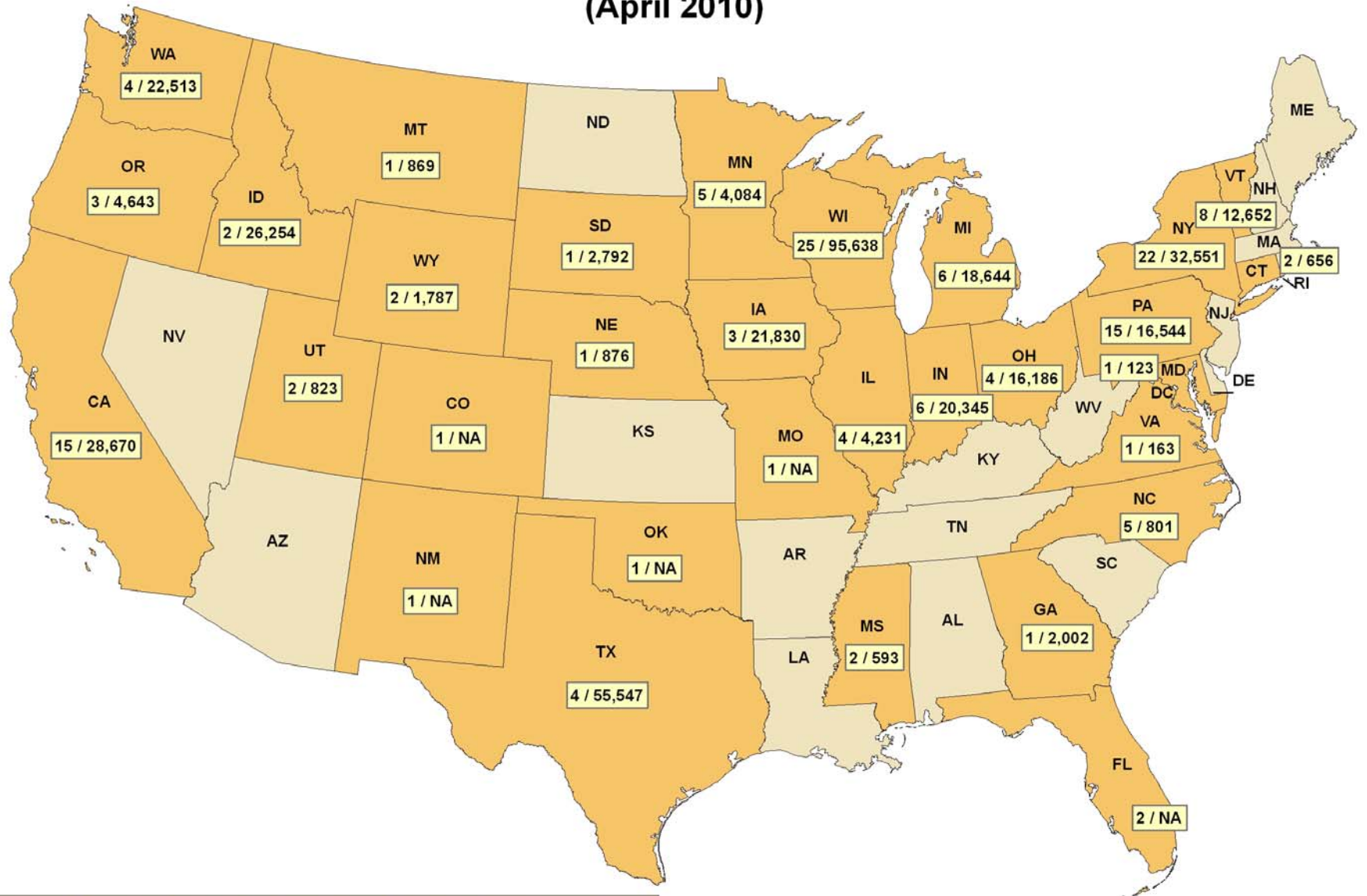
March 2008

Digesters do
not solve
nutrient issues!

Nutrient Management

- Digesters do not solve nutrient issues, however...
 - Anaerobic digesters provide energy (methane) that could help drive nutrient treatment/removal systems
 - Better manure feedstock for treatment technologies (post digestion)
 - More homogenous
 - Altered composition of manure
 - If solids separation, easier transport of N and P in solids fraction
 - Better crop/land application
 - More consistent product
 - More 'crop-ready' nitrogen (must be applied properly)

Operating Manure Digesters (April 2010)

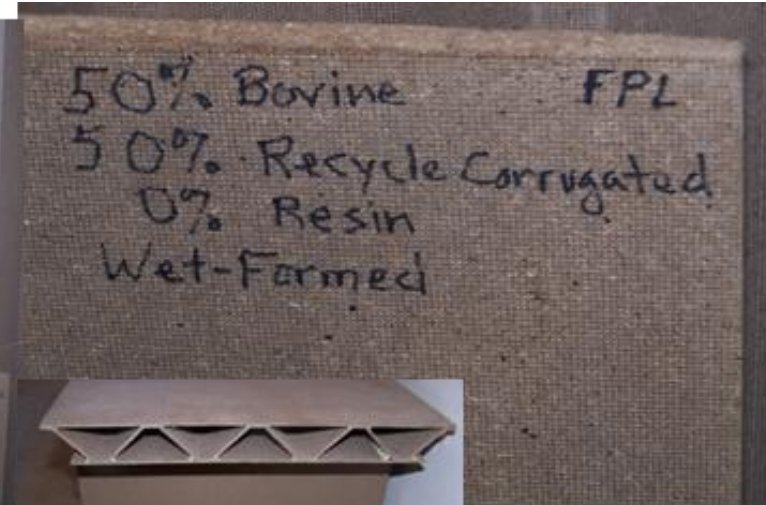
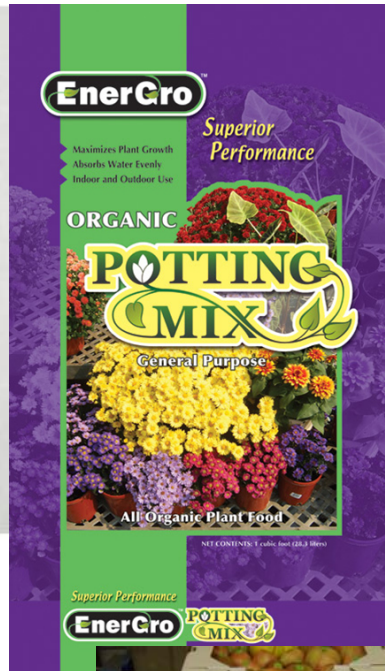


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Value-Added Benefits



Fiberboard/Decking



Building Materials



Cow Pots



Horticulture – soil/peat replacement

Crave Bros. Farm, Waterloo, WI





THE NEWS WASHINGTON



MAKING A
DIFFERENCE

Industry Activity

- American Biogas Council

- Promoting the advancement of anaerobic digestion technology in the United States
- www.americanbiogascouncil.org



- Dairy Power

- Releasing LCA for liquid milk industry
- Goal: Reduce methane emissions and produce power by advancing manure digester systems.
- Part of the US Dairy Sustainability Commitment (Innovation Center for US Dairy)
- <http://www.usdairy.com/Sustainability/CommitmentOld/Documents/ProjectSummaryDairyPower.pdf>



USDA Funding Support

- Conservation Innovation Grant
- EQIP
- Value Added Producer Grant
- Rural Energy for America Program (REAP)
 - \$35+ million to more than 100 manure digester projects since 2003

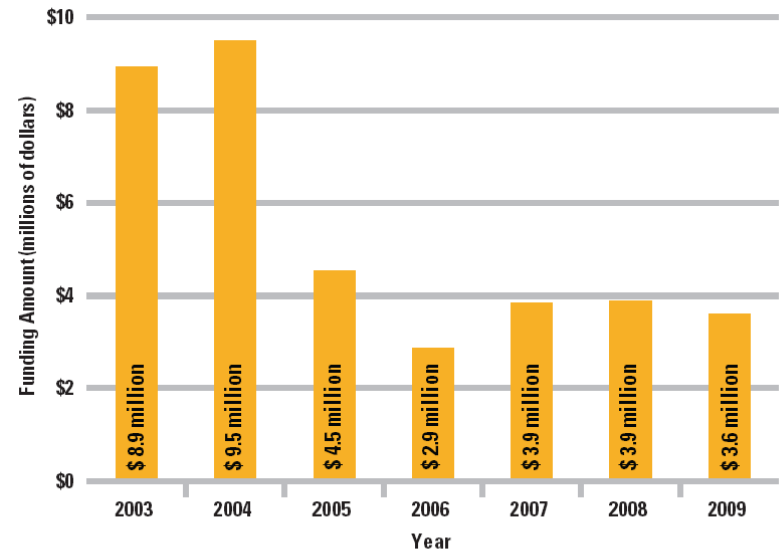


Figure 4. Annual USDA funding for anaerobic digesters at livestock operations



USDA/EPA Cooperation

- Interagency Agreement signed by USDA Secretary Vilsack and EPA Administrator Jackson on May 3, 2010.
- Will double the resources available to AgSTAR to advance digester systems.
- *“This is a smart way to transform what would be a harmful greenhouse pollutant into a source of renewable energy -- and make a profit for American farmers,”* said EPA Administrator Lisa P. Jackson. *“The AgSTAR program brings real benefits to our air and creates new opportunities for our farming community.”*
- *“The farms and ranches that dot our countryside can contribute greatly to addressing America’s long-term energy challenges and the partnership we are announcing today will not only help generate renewable energy, but provide new income opportunities for farmers and ranchers,”* said Agriculture Secretary Tom Vilsack.



USDA-EPA IAA: Overview

Direct Support from EPA to USDA

- Training in AD project screening/evaluation to build project pipeline
- Extension/marketing events
- Technical review (funding applications)
- Project pre-feasibility support***
- Guidance Documents
 - Status of US digester industry
 - Commercial status of biogas use processes
 - Digester system/biogas use evaluations
- Future – nutrients?

USDA Activity

- ARS and Innovation Center for US Dairy
 - R&D gaps (Cow of the Future, Dairy Power)
- Rural Development
 - Strong support through REAP; looking to levelize playing field for AD projects
- NRCS
 - EQIP/CIG, standards, growing activity and interest
- NIFA
 - 2011 – “year of the cow”
- Secretary Vilsack
 - “Digester a week”

Major Hurdles

- State, Federal and Coop/Utility Energy Policies
 - Tariffs/rates
 - Net Metering
 - Interconnection
 - Contract/PPA Negotiation
 - System Upgrades
- Access to Capital / Federal Incentives
- Permitting / Regulatory
 - Air emissions from energy generation equipment
 - Co-digestion of manure and other organic wastes
- Bottom Line – manure biogas energy cannot compete in most places with fossil fuels

AgSTAR Mission

- Voluntary effort of the USEPA jointly sponsored by USDA.
- The program encourages the use of methane capture and use (manure digester systems) at US livestock farms.
- These systems reduce methane emissions, achieve other environmental benefits, and generate energy.

AgSTAR Resources

- **General Outreach**
 - Annual AgSTAR Conference, AgSTAR Digest newsletter, Farm Extension Events, Workshops
- **Project Development**
 - *Managing Manure with Biogas Recovery Systems*
 - *Industry Directory*
 - *Funding Guide for Federal and State Resources*
 - *Market Opportunities for Biogas Recovery Systems*
- **Technical Analysis**
 - A Protocol for Quantifying and Reporting the Performance of Anaerobic Digestion Systems for Livestock Manures
 - Mass Balance Waste Management Evaluations
 - Dairy and Pig Manure Case Studies
- **Project Evaluation Tools**
 - AgSTAR Handbook - A Manual for Developing Biogas Systems at Commercial Farms in the United States
 - FarmWare - develops project specific feasibility assessments



For further information...

www.epa.gov/agstar

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