Community Manure Handling Systems
Annotated Bibliography
November 15, 2007

1. “Brown County Regional Composting Feasibility Study”, Harvey Economics, et. al., March 1, 2005, 252 pages. Available electronically from reviewer.

This report presents the results of a feasibility study for the development and operation of a composting facility in Brown County, Wisconsin, and the following are excerpts from the report.

> The need for a regional composting facility in Brown County originates from a convergence of several forces upon public and private organizations. This area is home to a sizable agribusiness sector, including dairy producers, animal rendering, and meatpacking companies, such as Packerland Packing and American Foods Group. The maintenance and processing of animals in these industries produces considerable amounts of organic waste that require disposal in a cost effective and environmentally compliant manner. The traditional practice of applying organic wastes to agricultural lands in this area has become problematic with decreasing land availability and new environmental regulations to limit phosphorus discharge, both of which raise costs and may curtail future agricultural business growth or even constrict current operations. Concurrently, GBMSD [Green Bay Metropolitan Sewerage District] faces wastewater treatment sludge disposal challenges. Capital must be raised and expended to meet environmental regulations and annual costs for incineration of the waste activated sludge and disposal costs of the ash are rising.
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> After considerable effort to identify a project configuration, a location, and an optimal development and financing strategy, the HE [Harvey Economics] team found that a composting facility to serve GBMSD, the meatpackers and the yard waste generators was financially infeasible. The tipping fees exceed the avoided costs in all cases studied. Tipping fees are high in large part because of the capital and operating costs for an in-vessel facility, which is believed to be the appropriate choice in this instance. The projected tipping fees are in line with or less than tipping fees for comparable waste streams and facilities elsewhere in the U.S. The Brown County waste stream generators would need to either contribute monies beyond their direct avoided costs, reconsider the participant mix to bring in waste streams with higher avoided costs, or receive greater public support.
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> Conversely, the Brown County dairy farmers’ waste stream may be feasibly composted in a windrow facility. There are a number of scenarios which are financial feasible, if outside public support is forthcoming. The justification for major public support is strong. If the in-vessel facility does not proceed, the meatpackers may participate with the dairy farmers to mutual financial benefit. Considerable organizational and planning efforts will be required to make this windrow facility a reality.

2. “Feasibility Study of a Central Anaerobic Digester for Ten Dairy Farms in Salem, NY”, Cornell University Fact Sheet FS-3, June 7, 2005, 6 pages. Available electronically on the internet.

Ten farms in New York contracted for a study of a centralized anaerobic digestion system to handle their manure. With a total of 3,700 cows providing approximately 74,000 gallons of manure a day, the goals included: (1) reduction of odor from current practices, (2) reduce ground and surface water contamination, (3) meet pending CAFO regulations, (4) product electricity, (5) produce bedding, and (6) provide economics of scale.

The study looked at 15 alternatives, with three options at the front end for solids separation, composting and use; anaerobic digestion of the liquids, and 5 alternatives for each system in handling the effluent from the digester. The net costs of the system ranged from $282 per cow per year to $560 per cow per year, and all alternatives were deemed to be uneconomical. In all systems analyzed, transportation of both the manure to the central facility and transportation of the effluent from the digester were significant costs, with manure transportation costs set at 1.4¢ per gallon.

3. "Feasibility Report. Jointly Owned Manure Digester in Dunn County, WI", Cooperative Development Services, June 2005, 42 pages. Three page executive summary available electronically from reviewer; whole report available in paper copy.

The following are excerpts from a three page executive summary:

> The purpose of this analysis is to evaluate the overall feasibility of a jointly owned manure digester system in Dunn County, Wisconsin. The proposed digester would be jointly owned by four dairy farms, which would form a separate business entity for the purpose of owning and operating the digester system.
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> The four farms were identified by Dunn Energy Cooperative (DEC), which organized a series of meetings in the summer of 2003 to discuss preliminary aspects of a jointly owned manure digester. This group conducted an analysis of each farm's size, manure output, needs, and capacity, and identified potential locations for the proposed digester.
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> The feasibility report includes analysis of hauling and transportation costs; options for legal forms for structuring the joint venture; permitting and regulatory issues related to the proposed project; a review of grant and low-interest loan programs that may be available to assist in financing the project; and 30-year financial projections.
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> This analysis is based on the following assumptions:
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> - The farms would purchase the digester assets, but Dairyland Power Co-op would purchase the generator and other assets necessary for generating electricity.
> - The owners of the digester system (the farms) enter into a 30-year biogas contract with Dairyland. Thus the farms are paid for biogas, not electricity.
> - The digester system will be constructed by Microgy as a turn-key package for the producer-owners. Microgy technicians maintain the digester, so dairy producers are not directly involved in day to day maintenance of the system.
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> The business model developed for this report proposes that the four dairy farms create an LLC which will own and operate the manure digester. The financial projections in this business plan demonstrate that the proposed venture is feasible only with significant subsidies from grant and loan programs, in addition to the capital invested by the producer members of the LLC:
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> A significant portion of the initial capital, over 47%, comes from grants which do not add to the project's debt load.
>
> The financial projections also include a no-interest 10-year loan which accounts for $400,000 of the capital needed.

4. "Economics of a Community Manure Management Facility in Southern Wisconsin. A Feasibility Analysis", John Reindl, May 2006, 2 page summary. Available electronically.

A consulting engineering firm has conducted a study for a community digester in southern Wisconsin to serve 13 farms with a total of 8,300 animal units at the current time, with an expected expansion to 11,300 AUs. Currently, the farmers are landspreading the manure from their farms, at an estimated annual cost of approximately $462,000.

It was found that the community digester would be more expensive than current costs; even with future expansion, the community system would cost more than direct landspreading. Capital costs would be $9.7 million for the current number of animal units and annual operating costs of $836,000, compared to revenues of $400,000 for electricity and $400,000 for sale of recovered solids.

The study also found that the use of a piping system to deliver manure to the facility would require an investment of $1.67 million and an annual operating cost of $247,000 and would be more expensive than truck transportation.

5. "Bio-Gas Methane Facility - Hooley Digester", Accessed on the web page http://www.potb.org/methane-energy.htm on May 18, 2006

The Port of Tillamook Bay has constructed a community digester to handle the manure from 4,000 of the county's 30,000 dairy cows. Manure is picked up by facility personnel, treated, and a portion returned to participating farms. Transportation costs will be offset by sale of electricity as "green power" and by sale of fiber recovered for use by a potting soil manufacturer. System benefits to the Tillamook community include: reductions in odors, pathogenic organisms, weed seeds, manure quantities and nutrients to be land-applied.

The original plan had been to build one large digester to serve the entire county, but the capital costs ($16 million) plus the transportation costs made such a system uneconomical. Instead, the goal is to build a series of more regional digesters, with the profits of the systems helping to pay for future systems.

6. "Tillamook, Oregon Methane Energy Development Program:, George DeVore, 2006 AgSTAR National Conference, April 24-26, 2006. Accessed on the Internet at http://www.epa.gov/agstar/pdf/conf06/devore.pdf on May 18, 2006

The Methane Energy Agricultural Development (MEAD) project of Tillamook Bay began in 1988 and has been going through several stages. When the initial Request for Proposals (RFP) was issued, there were no responses; in addition, the farmers had refused to pay any tipping fees at a proposed facility. In 2000-2001, the US Department of Energy provided $1.7 million in funding and the plan then proceeded forward, with construction taking place in 2002-2003, and the plant became fully operational in November 2003. In the 30 months of operation, it has processed 36 million gallons of manure, produced 3 million KWH of electricity and produced 72,000 cubic yards of compost fiber.

The economics have not worked out as expected – there have been problems with the gen-sets, the trucking of manure, and high levels of moisture in both the final fiber and the manure. The pro forma for the 2000-2001 system estimated a profit of $16,000 a year (and thus no tipping fees), while the 2003-2004 actual system costs resulted in a loss of $122,000. Potential solutions include:

- Tipping Fees – farmers to pay 80% of transportation costs
- Transport Improvement
- Farm Improvement
- Equipment Improvement
- Marketing Dry Fiber
- Better Power Rate 4.2¢ - 6.0¢
- CO_2 Credits - $2. +

The speaker concluded that the future of the digester system looked good and noted:

- Dairy benefit has been proven
- Dairy industry now understands the process and costs
- Environmental community is excited with the results
- Additional funding is needed to lower capital costs and standardize the operational process

7. “European Digester Technology”, Curt Gooch, 2006 AgSTAR National Conference, April 24-26, 2006. Accessed on the Internet at http://www.epa.gov/agstar/pdf/conf06/gooch.pdf on May 18, 2006, and notes from the conference, taken by John Reindl and proofed by Mr. Gooch

Two trips were taken in early 2006 to Denmark and Germany to visit biodigesters. Due to time constraints, the majority of the presentation of 98 slides was on the systems in Denmark. There are 20 community digesters, built from 1984 to 1998. Government regulations on manure storage and land application, and subsidies for both the capital costs and energy sales from community systems helped foster the formation of these systems; reductions in the subsidies has resulted in no new systems built since 1998, although several are in planning.

Besides manure, the plants often take in other digestible materials, such as food processing residues.

Revenues at the plants are split almost evenly between electricity sales, heat sales and tipping fees for the receipt of materials. An evaluation of the economics of 17 of the plants in 1999 conclude that 10 either broke even or made money, while 7 had a loss. Gas storage structures are often included at the plants to be able to store gas during “off peak” times for use when prices or demand is higher.

8. ‘Status of Biogas Across the “Big Pond” ‘, Curt Gooch, The Manager, April 2006, 2 pages. Accessed on the Internet on May 18, 2006 at http://www.ansci.cornell.edu/prodairy/manager/2006pdf/aprilp40.pdf

In a sidebar of the article, the following quick summary is provided:

Denmark’s biogas system

The average Danish farm size is smaller than the United States’ so economies of scale don’t sufficiently exist to allow most farms to own and operate their own anaerobic digester. Instead, cooperatives formed by farmers started and own most Danish biogas plants.

Cooperative members don’t pay to have their waste treated at the biogas plant. Instead, they gain economic benefits as a result of plant operation. Their cost to store manure long term as required by law is reduced. And farmers save money when they don’t haul manure to distant fields; treated manure from the plant is taken directly to fields at some farms.

Vacuum trucks transport raw manure from the source farm to the biogas plant and also haul industrial waste to the plants. Industrial wastes are generally farm-product processing waste, such as slaughter house wastewater, and nonfarm material such as byproducts from making alcohol. Danish law allows biogas plants to mix as much as 25% industrial waste with manure. Manure and industrial wastes are stored separately until they are mixed, pasteurized and digested.

Most Danish digesters were designed with a 15-day hydraulic retention time, while U.S. digesters tend to have a longer time. Less retention time helps cut capital costs and improves the systems’ economic viability. Gas generation efficiency and quality in Danish digesters vary from site to site. Some sites produce 75 ft3 of biogas per ft3 of biomass influent with biogas methane content as high as 72%.

Generated biogas is stored short term in double-wall flexible membrane structures. The space between the two walls is inflated with ambient air. The inner membrane is elastic and expands and contracts based on the volume of gas that must be stored.

Gas production is not uniform so surges in produced gas are stored until they're consumed by the engine-generator set. Digester effluent is stored at the biogas site for several days in a covered tank before being transported back to the source farms. Of the biogas generated at the plant, 20% is collected in the post-digestion storage tank.

9. “Study Tour Visiting Biogas Plants in Denmark 21-26 February 2004”, Central Kazakhstan Education Biogas Center, March 2004, 8 pages. Accessed on the Internet at http://www.inforse.org/europe/kz_biogas.htm on May 1, 2006.

In February 2004, a study tour of six bio-digesters in Denmark was taken by people from Kazakhstan, visiting the following facilities:

- Ribe
- Filskov
- Gosmer
- Hegndal
- Skinnerup
- Fårborggård

Three of these facilities are community systems (Ribe, Filskov and Gosmer).

Ribe began operation in 1990, receiving manure from 69 farmers along with food processing residues. The processed manure is used by about 72 farmers, with a system of 25 regional storage facilities. The biogas is shipped to the local municipality for use in their CHP system.

Filskov was built in 1995 and receives manure from 11 farms (95% cattle, 5% hog) as well as food processing residues. A CHP system is used to generate electricity and use the heat. The processed materials are used by farmers.

Gosmer was established in 1992. Few details are provided in the trip report, but ownership includes 8 pig farms, an electrician and a smith

10. Google Search, “Danish Centralised Biogas Plants“, May 18, 2006

This Google search turned up 48 sites. Some of these include:

“Danish Centralised Biogas Plants. Plant Descriptions”, Bioenergy Department, University of Southern Denmark, 2000, 28 pages, http://websrv5.sdu.dk/bio/pdf/rap2.pdf. One page descriptions are given of 18 biogas plants in Denmark.

“Centralised Biogas Plants - Integrated Energy Production, Waste Treatment and Nutrient Redistribution Facilities“, Danish Institute of Agricultural and Fisheries Economics, 1999, 32 pages, http://www.ub.es/bioamb/PROBIOGAS/centralcodig_bilan1999.pdf. Gives a summary of the Danish conditions, technology, finances and economic costs and benefits.

“Biogas plants in Denmark: successes and setbacks”, R.P.J.M. Raven and K.H. Gregersen, Renewable and Sustainable Energy Reviews preprint version, 2005, 18 pages, http://www.mestverwerken.wur.nl/home/..%5CInfo%5CBibliotheek%5Cpdf/Biogas%20plants%20in%20Denmark%20successes%20and%20setbacks.pdf

> The abstract notes “We argue that three factors have been important for the current status of biogas plants in Denmark. First, the Danish government applied a bottom-up strategy and stimulated interaction and learning between various social groups. Second, a dedicated social network and a long-term stimulation enabled a continuous development of biogas plants without interruptions until the late 1990s. Third, specific Danish circumstances have been beneficial, including policies for decentralised CHP, the existence of district heating systems, the implementation of energy taxes in the late 1980s and the preference of Danish farmers to cooperate in small communities. The current setback in biogas plants is mainly caused by a shift in energy and environmental policies and limited availability of organic waste.”

11. “Centralised Anaerobic Digestion”, Jorgen Fink, Managing Director, Farmatic Biotech Energy UK Ltd, 5th UK Bioenergy Conference, 2002, 10 pages. Accessed on May 15, 2006 on the Internet at http://www.ienica.net/usefulreports/Bioenergyproceedings.pdf

Both Denmark and Germany have 20 community bio-digesters and short summaries are provided for community bio-digesters in both Denmark and Germany, including the following plants:

Denmark

Ribe
Hashøj
Nysted

Germany

St. Michaelisdonn
Neubukow

In addition, Holsworthy Biogas Ltd. was established the UK in 1998. In 2000, farmatic was appointed as the turn-key contractor to build, finance and assist in the operation of the biogas plant. Furthermore, farmatic is a shareholder in the company. Full plant operation was expected in the spring of 2002.

For the plants in all three countries, government subsidies were given for the capital costs of the plants. In addition, the plants benefited from "green" energy prices. In both Denmark and Germany, a variety of materials are digested, and the energy is often utilized by Combined Heat and Power (CHP) systems.

The reasons for the development of community systems is based on a number of advantages, including:

- Economy of scale
- Re-distribution of nutrients (from manure and food residues)
- Professional operation
- Better use of heat
- Possible better price for electricity
- Better platform for new developments

12. "Holsworthy Biogas hits the financial buffers", Rick Pendrous, Food Manufacture, 07 March, 2005 Accessed on the Internet on May 18, 2006 at http://www.foodmanufacture.co.uk/news/fullstory.php/aid/1221/Holsworthy_Biogas_hits_the_financial_buffers.html

According to the article:

> Holsworthy Biogas, the troubled waste-to-energy plant in north Devon, has gone into administration following a breach of its financing conditions and its inability to fund the reinvestment necessary to upgrade the plant and comply with operational conditions set by the Environment Agency.
>
> Although administrator BDO Stoy Hayward are is said to be confident of finding a buyer for the business, Holsworthy's continuing problems (Food Manufacture May 2004, p14) are a salutary warning to others considering embarking on similar ventures.
>
> Biomass -- including composting and waste to energy plants -- are widely seen as preferred ways of meeting tougher environmental legislation expected in the future.
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> Holsworthy takes food waste from companies, such as Cornish pasty manufacturer Ginsters, as well as other agricultural waste for conversion into electricity. However, it hadn't been able to generate sufficient income from customers to support the reinvestment that was necessary.

13. " Feasibility Study of Anaerobic Digestion Options for Perry, NY", Town of Perry, Wyoming County, NY, 2002, 27 pages. Accessed at http://counties.cce.cornell.edu/Wyoming/agriculture/programs/anaerobic_digestion/ on June 16, 2006.

This study looked at technical and economic feasibility and possible organizational structures for three alternative configurations of biodigesters to handle the manure of four dairy farms in the Town of Perry. One

systems was for a central facility to serve all four farms, a second alternatives was to have two digesters, each serving two farms, while the third alternative was for each farm to have its own digester. The primary objectives of the study were to:

- Minimize odor problems that result from current manure management practices;
- Reduce the potential for negative impacts on the environment from existing practices by providing feasible alternatives to farmers;
- Increase the use of byproducts resulting from the breakdown of manure; and,
- Increase the number of industries in Perry by providing local sources of energy and byproducts generated from manure digestion.

The study found that the technology existed for meeting these objectives, and that the most economic approach would be for each farm to have its own system, using a common system design to reduce design costs. The most expensive alternative – and the one with the most structural problems – was the configuration of one digester to serve all four farms.

Besides the technical and economic feasibility of the system, the study also surveyed farmers on their willingness to participate (and invest) in the system and a variety of markets for energy and markets that would be recovered from the system.

14. "Developing a Community Manure Digester Model of Wisconsin", Mary E. Myers and Chris Deisinger, Cooperative Development Services, Madison, WI, June 2006, 17 pages plus two spreadsheets of 5 worksheets each

The Wisconsin Focus on Energy program provided partial funding for this study, which began by looking at two potential community systems, one in Pepin County and the other near Mondovi in Buffalo County. The Mondovi study was not moved forward, however, as there are only about 1,000 cows in the area and the consultant's experience is that about 2,000 cows are necessary to make the project economical.

In the Pepin County study, five farms located within a township have 2,000 cows and it is estimated that they generate about 36,000 gallons of dairy manure a day, excluding parlor water. The cost of an anaerobic digester with a gen-set and solids separator would be about $2.1 million and generate just over 5 million KWH of electricity a year. Transportation was a major operational cost factor, with a basic rate of $65 an hour (plus fuel surcharges for gasoline over $2 a gallon) for a contract carrier, who estimated that 6 hours a day of hauling would be necessary. Given an estimated cost of gasoline at $3 a gallon, this calculates to an annual cost of some $156,600 for the first year.

It was found that the system would only be economical if grants could be obtained for one-third to one-half of the capital costs, and even then, the system has a negative payback for the first 10 years, based in part on electricity purchase rates of 4.94¢ per KWH, along with recovery of solids for bedding. However, at energy rates paid in other areas of Wisconsin (such as the 6¢ per KWH paid by Alliant Energy and WE), the system would be economical in less than 5 years, again assuming grants of one-third of capital costs.

15. "Cayuga County, New York Pioneers Community Digester Program", *BioCycle*, April 2007, pages 56-58, accessed on the Internet at http://www.jgpress.com/archives/_free/001311.html on May 7, 2007; "Cayuga Regional Digester and Bioenergy Enterprise. Phase-I: Feasibility ", accessed on the Internet at http://www.manuremanagement.cornell.edu/Docs/Cayuga%20Regional%20Digester%20poster.pdf on May 7, 2007; and "A Vision for Manure-handling will Soon be Reality", by Kamyar Zadeh, accessed on the Internet on May 7, 2007 at http://www.manuremanagement.cornell.edu/Docs/Innovations%20in%20MM-%20July%202006.pdf, telephone conversation with Jim Hotaling, Cayuga County Soil and Water Conservation District, May 15, 2007

The Soil and Water Conservation District of Cayuga County, NY has taken the lead in the development of a community bio-gas system to handle both livestock manure as well as food scraps from food processors. The system is designed to take in 39,000 gallons of manure per day from approximately 1,500 cows as well as up

to 50 tons/day of food residues. The specific food residues are not yet known, and none are under contract. However, there are considerable amounts of fats and greases that are being landfilled in the area, and these materials would be one potential feedstock, as well as materials from cheese factories. It is expected that a tipping fee would be charged for food residues, but less than the costs of alternative disposal systems. Mr. Hotaling would like to get the system operational on manure first and then bring in food residues, perhaps starting first with the food scraps from the county jail and nursing home.

Located at the campus of the District headquarters, the facility is designed to produce 625 kW of power, which is to be used both at the campus as well as nearby county buildings, including the jail and nursing home. Excess electricity will be sold to the grid. In addition, the facility will be equipped with a screw press to separate solids from liquids in the effluent, with approximately 34,000 gallons per day of liquids to be returned to the farms providing manure. An estimated 25 tons of solids will be recovered per day and composted with other materials.

The digester is a hydraulic-mix system from the German firm GBU [English web page http://www.gbunet.de/startseite-e.html], and is marketed in the US by ECO Technology Solutions. The hydraulic-mix system eliminates moving parts (such as an electric stirring motor) within the digester and is said to also eliminate the need for internal cleaning of the digester.

The system is expected to be completed by the end of 2007. Total cost of the project is estimated at $3.2 million, with the financing coming from the New York State Energy Research Development Authority (NYSERDA), the U.S. Department of Agriculture (USDA), the Environmental Protection Agency (EPA), and New York State Department of Agriculture Markets. Cayuga County and the Cayuga County Soil and Water Conservation District are providing in-kind services valued at $100,000 and $300,000 respectively. In addition to selling energy and compost, the system would also seek to sell carbon credits.

Mr. Hotaling emphasized that the economics of the system will not be known until the system is operational – the business plan of Eco Tech is, of course, just a plan, and reality may be quite different than the plan. He is not sure, for example, if the revenues will cover the facility's expenses.

16. "Biosolids and Sustainable Agriculture: The Cover [sic] Area Regional Digester Manure and Biosolids Processing Facility", Jason D. Wert, et. al., Herbert, Rowland & Grubic, Inc., WEFTEC 2005, pages 6504-6512; "Cove Manure Digester Receives Grant for Pilot Test", PA Environmental Digest, September 1, 2006, accessed on the Internet at http://www.paenvironmentdigest.com/newsletter/default.asp?NewsletterArticleID=5100 on October 23, 2007; "Feature: The New Math of Energy Production: Cows + Manure = Gas + Electricity", PA Environmental Digest, February 11, 2005, accessed on October 23, 2007 on the Internet at http://www.paenvironmentdigest.com/newsletter/default.asp?NewsletterArticleID=1627; personal conversation with Jason Wert, October 23, 2007

The Morrison's Cove area of Blair and Bedford Counties, Pennsylvania, has a high concentration of dairy animals – approximately 25,000 – and limited options for the management of the manure. In 2002, a study was initiated to determine what methods would be available to improve the handling of the manure, and, based on this work, the Cove Area Regional Digester project was formed.

The feasibility study concluded that a central facility to handle both manure and possibly wastewater treatment plant sludges would both protect the environment and be economical. Starting with a complete mix thermophilic anaerobic digestion process to produce methane gas that would generate 2.2 megawatts of electricity, the system would then separate the solids with a centrifuge and dry them with the heat from the internal combustion engines that burn the methane and drive the generators. The amount of heat available would also be sufficient to accept other sludges for drying. The dried material could then be sold for its nutrient and organic benefits.

After the solids are separated, the liquid stream would be treated both by membrane bioreactors and pure oxygen to reduce the chemical oxygen demand (COD), total nitrogen and total phosphorus.

The processing of these two streams would reduce odor – including ammonia discharges to the air – and both nitrogen and phosphorus discharges to groundwater and surface water.

The plant is designed to handle the manure of approximately 8,000 cows, and 175,000 gallons of manure a day, with pickup and transportation provided by the project. Estimated capital cost of the facility is $25 million – including an $8 million waste water treatment plant, with annual revenues expected at $2.4 million from power sales, tipping fees for non-manure biosolids, the sale of recovered solids, and credits from a state nutrient management trading program. Annual expenses are estimated at $2.1 million, including depreciation. In 2006, a grant was received for a 60 day test of the process and additional grant funding is being sought for construction.

If financing is obtained, construction is expected to start in 2008, with ownership perhaps by an non-profit organization that has been focused on this project or a municipal utility.

17. " Environmental Power Celebrates Completion of Huckabay Ridge Facility with Texas Dignitaries", accessed at http://ir.environmentalpower.com/releaseDetail.cfm?ReleaseID=273102 on November 13, 2007; "Largest Manure-to-Methane Plant Begins Operation", accessed at http://www.greenbiz.com/news/news_third.cfm?NewsID=36217 on November 13, 2007

The Huckabay Ridge anaerobic digestion system in Stephenville, Texas, will accept manure from local farmers at no cost, with the farmers responsible only for transportation costs. The plant is designed to accept some 200 tons of manure a day, along with restaurant greases and produce both methane gas cleaned up to sell to natural gas pipelines and a compost to be used by the Texas Department of Transportation. Plant cost is put at $18.5 million, and the grand opening was the first week of November, 2007.

18. "Innovation & Action on the Chino Basin Organics & Manure Management Strategy – Energy - Environmental Quality & Public/Private Partnerships", *Proceedings. Animal Residuals 2002. Conference and Workshop. May 6-8, 2002. Agricultural Animal Manure – Management, Policy and Technology*, Charles Egigian-Nichols, Richard Atwater, and Robert Feenstra, General Manager; *Inland Empire Dairy Manure to Energy "Cow Power" Renewable Energy Program*, 37 Power Point slides, April 2006, AgStar conference, Madison, WI . Accessed at http://www.epa.gov/agstar/pdf/conf06/clifton.pdf on November 15, 2007

The Inland Empire Utilities Agency (IEUA) provides public water and wastewater services to approximately 700,000 people residing in seven communities east of Los Angeles County. The Agency owns and operates facilities with a combined treatment capacity of 53 million gallons per day producing tertiary effluent and 180 wet tons per day of Class B biosolids.

In the Inland Empire region, there are approximately 275 dairies contribute over 6 million tons per year of fresh manure. This is the densest concentration of dairy cattle in the United States. The numbers of operating dairies and related livestock facilities in the area dropped from a high of 320 in 1996 to 306 in 2000. The total number of dairy animal units and milking cows appears to be relatively constant over the past five years. Various data sources indicate the total number of dairy animal units at between 400,000 and 500,000 at any one time. The number of lactating cows appears to be trending slightly down to a current level around 275,000.

As part of its wastewater treatment system, IEUA has built an anaerobic digestion system to treat dairy manure and recovery methane gas and to compost the recovered solids. The original configuration included the following was to process scraped dairy manure in a plug flow digester. However, some operational problems were encountered and the digester for the next phase was converted from a plug flow digester to a complete mix thermophilic design with a capacity of 315 liquid tons a day.

As of the spring of 2006, IEUA, was going through an expansion to add a second system, with another 300 tons a day capacity for manure and 90 tons a day of food scraps. Construction was expected to be complete in late 2006 and a search of the IEUA web page did not turn up additional information on the system.

Extensive state and federal funding -- $22.6 million -- was obtained for the capital costs of the project. Neither reference discusses the charges that the farms must pay for the handling of their manure.

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