

**CONSIDERATION OF STAFF  
RECOMMENDATION REGARDING  
FINANCING PROJECTS USING NEW  
BIOSOLIDS CONVERSION TECHNOLOGY**  
April 23, 2008

**STAFF SUMMARY – CPCFA**  
**Prepared by: *Michael Smith***

**ISSUE:** As a matter of policy, should the State allow tax-exempt bonds to be used for projects that use anaerobic digestion of animal wastes to process manure and other organic wastes and produce biogas as a fuel source for industry?

**BACKGROUND:** In recent months there has been interest in using tax-exempt bonds to finance projects that use conversion technology to turn animal waste and other organic wastes into a fuel source called biogas.

CPCFA has received a request from BioEnergy Solutions, LLC (BioEnergy) to fund an anaerobic digester project in Fresno County. CDLAC has received an allocation request from the California Statewide Communities Development Authority for Microgy, Inc. for a similar project. Because these projects include technology not previously approved, CDLAC has asked CPCFA to prepare a technology review. This review will cover technology used by both projects.

**BioEnergy:** At the January 23, 2008 meeting, the CPCFA Board approved an Initial Resolution (IR) for BioEnergy. BioEnergy is a small business which proposes to construct and install a waste manure digester that will convert waste cow manure into biogas on an existing dairy in Fresno County.

The BioEnergy project expects to capture the biogas resulting from the breakdown of dairy cow manure. The project entails the purchase of a digester, a gas upgrade plant, additional piping, agitator pumps and the construction of a manure processing pit. PG&E has entered into a contract with BioEnergy to purchase all biogas produced by the project. BioEnergy expects to request a Final Resolution (FR) from the CPCFA Board sometime in 2008.

**Microgy:** Microgy Inc. is a sole subsidiary of Environmental Power Corp. (AMEX: APG). Environmental Power Corp. (EPC) has developed, owned and operated hydroelectric plants, municipal waste projects, coal-fired generating facilities and clean gas generation and energy recovery facilities. In 2001 EPC purchased Microgy. Microgy is headquartered in Golden Colorado and holds the exclusive North American license to a proprietary European anaerobic co-digestion technology. Microgy has been operating three applications of this technology on three Wisconsin dairies for approximately three years. In 2006, Microgy received tax-exempt bond financing in the amount of \$60,000,000 from the state of Texas to build and operate four anaerobic co-digestion facilities. Microgy's current CDLAC request is to finance the three anaerobic digesters it has in place and permitted in California's Central Valley. All biogas

produced by Microgy's facilities in California will be piped directly into PG&E's natural gas transmission lines per contract similar to BioEnergy.

**BIOGAS TECHNOLOGY:** Anaerobic (in the absence of oxygen) digestion is a biological process that produces a gas principally composed of methane (CH<sub>4</sub>) and carbon dioxide (CO<sub>2</sub>) otherwise known as biogas. These gases are produced from organic wastes such as livestock manure, food processing waste, and the addition of bacteria.

Anaerobic processes can occur naturally or in a controlled environment. In the animal waste anaerobic process, organic waste such as livestock manure, food waste and various types of bacteria are put in an airtight container, called a digester, so the process can occur. Methane producing bacteria are most active in two temperature ranges, 95° to 105°F (mesophilic) and 130° to 135°F (thermophilic). Depending on the waste feedstock, temperature and the system design, biogas is typically 55 to 75 percent pure methane. State-of-the-art systems report producing biogas that is more than 95 percent pure methane.

Methane, the primary component of bio-gas, can be used to fuel a variety of cooking, heating, cooling, and lighting applications, as well as to generate electricity. Methane (CH<sub>4</sub>) is a greenhouse gas that remains in the atmosphere for approximately 9-15 years. Methane is over 20 times more effective in trapping heat in the atmosphere than carbon dioxide (CO<sub>2</sub>) over a 100-year period.<sup>1</sup>

Key by-products of anaerobic digestion include digested solids and liquids, which may be used as soil amendments, animal bedding or liquid fertilizers. Odor is reduced, and weed seeds and pathogens are killed during the digestion process, thus reducing the need for herbicides and pesticides on the farm.<sup>2</sup>

Common digester misconceptions include that anaerobic digestion and the resulting biogas production will reduce the quantity of manure and the amount of nutrients that remain for utilization or disposal - an anaerobic digester does not make manure disappear. But Microgy estimates a 40-50% reduction in solids and a reduction in manure volume from its process.<sup>3</sup>

Many anaerobic digestion technologies are commercially available and have been demonstrated for use with agricultural wastes and for treating municipal and industrial wastewater. In addition to animal manure, municipal sewage also contains organic biomass solids, and many wastewater treatment plants use anaerobic digestion to reduce the volume of these solids. Anaerobic digestion stabilizes sewage sludge and destroys pathogens. Most wastewater treatment plants that use anaerobic digesters burn the gas for heat to maintain digester temperatures and to heat building space.

The same anaerobic digestion process that produces biogas from animal manure and wastewater occurs naturally underground in landfills. Most landfill gas results from the decomposition of cellulose contained in municipal and industrial solid waste. Unlike animal manure digesters,

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<sup>1</sup> US EPA at [www.epa.gov/methane](http://www.epa.gov/methane).

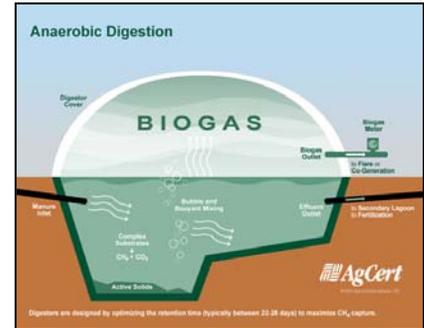
<sup>2</sup> USDA, Rural Program success stories, <http://www.usda.gov/rus/electric/success/wi-success.htm>.

<sup>3</sup> Per telecom with chief engineer for Microgy, 4/10/08.

which control the anaerobic digestion process, the digestion occurring in landfills is an uncontrolled process of biomass decay. Capturing landfill gas before it escapes to the atmosphere allows for conversion to useful energy.<sup>4</sup> The State typically receives applications for and funds the requirement to capture methane gas from landfills.

The most common types of agricultural waste anaerobic digesters are explained below.

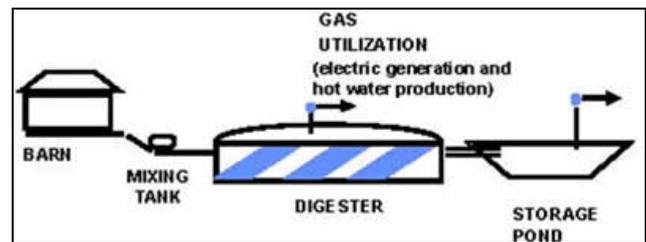
**Covered lagoons** – A pool of liquid manure is covered with an impermeable cover that collects biogas as it is produced from flushed manure. The cover is constructed of an industrial fabric that either rests on solid floats laid on the surface of the lagoon or is anchored to the banks. An anaerobic lagoon is best suited for organic wastes with a total solids concentration of 0.5 to 3 percent. Climate is a key factor in the performance of covered lagoons as they are not heated.<sup>5</sup> About 18 percent of all digesters presently in use in the U.S. are covered lagoon systems.<sup>6</sup> Methane collection efficiency is estimated at 95% to 100%.<sup>7</sup>



**Complete Mix Digester** – is a tank designed above or below ground as part of a manure management system to handle manure containing 2 to 10 percent solids. The digester is heated and mixed mechanically or with gas-mixing systems to keep the solids suspended. This maximizes biological activity for destruction of volatile solids, methane production and odor reduction.<sup>8</sup> This is the most expensive system to install and operate, but it's particularly appropriate for operations that wash out manure. About 28 percent of all digesters in use in the U.S. are of this type. Methane collection efficiency is estimated at 98% to 100%.<sup>9</sup>



**Plug flow** – The plug flow digester design is a long linear reactor wherein wastes move slowly through the reactor as a "plug." Plug flow digesters are often built below ground level, with an airtight expandable cover. Manure is collected daily and added to one end of the trough. Each day a new "plug" of organic wastes is added, slowly pushing the other manure down the trough. Plug flow digesters are usually heated to maintain optimal temperatures.<sup>10</sup> Most appropriate for livestock operations that remove manure



<sup>4</sup> Oregon Department of Energy, Biomass energy, Biogas Technology, <http://www.oregon.gov/ENERGY/RENEW/Biomass/biogas.shtml>.

<sup>5</sup> Dairy Power Production Program Dairy Methane Digester System Program Evaluation Report, prepared for the California Energy Commission by Western United Resource Development, Inc. August 2006.

<sup>6</sup> Excerpt from National Sustainable Agriculture Information Service publication "Anaerobic Digestion of Animal Wastes: Factors to Consider" 2006, available at <http://attra.ncat.org/attra-pub/summaries/anaerobic.html>.

<sup>7</sup> EPA & AgSTAR-Climate Leaders Draft Offset Protocols – Managing Manure with Biogas Recovery Systems.

<sup>8</sup> Penn State College of Agricultural Sciences – [www.biogas.psu.edu/](http://www.biogas.psu.edu/).

<sup>9</sup> EPA & AgSTAR-Climate Leaders Draft Offset Protocols – Managing Manure with Biogas Recovery Systems.

mechanically rather than washing it out, the plug-flow system accounts for more than half of all digesters presently in use.<sup>11</sup>

BioEnergy Solutions' covered lagoon uses an impermeable 60mil HDPE (high-density polyethylene, approx 1/16" thick) cover and is double lined on the inside with the same 60mil HDPE.

Microgy uses a variation of the complete mix, above-ground, digester technology (co-digestion). Up to 15 percent of food waste is added, as well as manure, to the mix and a higher temperature increases biogas production. (See photo at right.)



**BIOGAS IN CALIFORNIA:** Issued in April 2006, Executive Order S-06-06 called for California to increase its share of biofuel production and electricity from biomass (plant material, vegetation or agricultural waste used as an energy source). The order stemmed from, among other things, increased public concern over escalating fuel costs and reliance on petroleum, and the desire for strong State advocacy and commitment for improving resource management and mitigating climate change. Materials in the waste stream can be used as resources to produce alternative renewable energy and biofuels, thereby increasing diversion and developing new markets. Executive Order S-06-06 also established targets for production and use of biofuels and directed relevant State agencies to work together to achieve the targets established in the Executive Order.<sup>12</sup>

A group of State agencies, the Bioenergy Interagency Working Group ("Working Group"), chaired by the California Energy Commission (CEC), developed the Bioenergy Action Plan for California and presented it to the Governor in July 2006. The Action Plan basically calls for a consistent and coordinated State policy on bioenergy and to create the necessary institutional and regulatory changes that will substantially increase the production and use of biomass for energy in California. Specifically, the Secretary for the California Department of Food and Agriculture (CDFA) will evaluate the potential for regional manure management centers as potential sites for dairy bio-digesters in the San Joaquin Valley and at other suitable locations.<sup>13</sup>

A July 2007 follow-up report by the Working Group states that CDFA has collaborated with the State Water Resources Control Board and Regional Water Quality Control Boards and the farm community to strengthen water protection and discharge requirements for dairies, designated to produce biogas, while protecting water quality. CDFA has participated in the development of dairy digester reporting protocols by the California Climate Action Registry (Registry), which will be adopted by the California Air Resources Board (CARB), and has worked with the California Public Utilities Commission (CPUC) to facilitate on-the-farm power sales and distribution.<sup>14</sup>

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<sup>10</sup> Dairy Power Production Program Dairy Methane Digester System Program Evaluation Report, prepared for the California Energy Commission by Western United Resource Development, Inc. August 2006.

<sup>11</sup> Excerpt from National Sustainable Agriculture Information Service publication "Anaerobic Digestion of Animal Wastes: Factors to Consider" 2006, available at <http://attra.ncat.org/attra-pub/summaries/anaerobic.html>.

<sup>12</sup> Excerpted from California Integrated Waste Management Board Strategic Directive 9 (SD-9).

<sup>13</sup> Bioenergy Action Plan for California, prepared by Bioenergy Interagency Working Group, July 2006.

<sup>14</sup> Bioenergy Action Plan – Progress to Plan, July 2007.

The CEC presented “California’s Bioenergy Action Plan: The Role of Dairy Biogas” at the AgSTAR National Conference in Sacramento on November 20, 2007. The CEC concluded that “State policy initiatives, such as the Bioenergy Action Plan, the Global Warming Solutions Act, and California’s Renewable Fuel Standard, support the production of biogas from California’s dairies. Biogas produced from California’s dairies has the potential to address multiple policy objectives. Methane recovery from dairies supports State climate change goals. Many digesters are not cost-effective investments for farmers. Incentives are needed to make them economically viable.”<sup>15</sup>

There are ongoing efforts by the Working Group to coordinate policy issues, study technical, economic and environmental performance, and assist in creating better permitting coordination between various state agencies.

**GLOBAL CLIMATE CHANGE:** The California Legislature and Governor Schwarzenegger approved Assembly Bill 32, the California Global Warming Solutions Act of 2006, which requires the State to cut total greenhouse gas (GHG) emissions such as carbon dioxide (CO<sub>2</sub>) by 25 percent by 2020. Continuing California’s long-standing tradition of innovation on environmental issues, Assembly Bill 32 has given CARB a leadership role in forging new approaches to diminishing the State’s carbon footprint working with other State agencies.

CARB convened the Economic Technology Advancement Advisory Committee (ETAAC) in 2007 to study and give policy and technology recommendations for reducing GHG emissions in California. The report includes recommendations for GHG reduction strategies in the areas of finance, transportation, industrial commercial and residential end users, electricity and natural gas, agriculture, forestry, and water policy.<sup>16</sup>

A final report prepared by ETAAC presented to CARB quantifies the possible effect manure-to-energy facilities would have on reducing GHG emissions. The agriculture and forestry sector make up approximately 8 percent of the total carbon emissions in California. This amounts to about 30 million metric tons of carbon dioxide equivalents (MMTCO<sub>2</sub>E). The report estimates that manure-to-energy facilities have the potential to reduce GHG emission by as much as 6 MMTCO<sub>2</sub>E.<sup>17</sup>

Processing manure using anaerobic digestion technologies reduces methane emission while producing renewable energy. But because these systems require investment and expertise, the technical potential is expected to be closer to 3.1 MMTCO<sub>2</sub>E. There are well-established protocols for quantifying the amount of emissions reductions achieved with these systems, including the recently developed “Livestock Project Reporting Protocol” by the California Climate Action Registry.<sup>18</sup>

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<sup>15</sup> California’s Bioenergy Action Plan: The Role of Dairy Biogas. AgSTAR National Conference, Nov. 27, 2007.

<sup>16</sup> Per AB 32, "Greenhouse gas" or "greenhouse gases" includes all of the following gases: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.

<sup>17</sup> Recommendations of the Economic and Technology Advancement Advisory Committee (ETAAC) FINAL REPORT February 11, 2008.

<sup>18</sup> Recommendations of the Economic and Technology Advancement Advisory Committee (ETAAC) FINAL REPORT February 11, 2008.

**SUPPORT FOR BIOGAS:** The AgSTAR Program is a voluntary effort jointly sponsored by the U.S. Environmental Protection Agency (EPA), the U.S. Department of Agriculture, and the U.S. Department of Energy. The program encourages the use of methane recovery (biogas) technologies at confined animal feeding operations that manage manure as liquids or slurries including anaerobic digesters. “Anaerobic digesters are particularly effective in reducing methane emissions but also provide other air and water pollution control opportunities.”<sup>19</sup>

According to AgStars’ 2007 update on Anaerobic Digester Systems, construction of anaerobic digestion systems for livestock manure stabilization and energy production has accelerated substantially in the past several years. EPA estimates that there are currently about 111 digesters operating at commercial livestock facilities in the United States. In 2007, farm digester systems produced an estimated 215 million kilowatt hours equivalent of useable energy. Besides generating electricity, some operations use the gas as a boiler fuel, some upgrade the gas for injection into the natural gas pipeline, and some flare gas for odor control.<sup>20</sup>

The California Renewables Portfolio Standard (RPS) Program was established by Senate Bill 1078. The statute requires that a retail seller of electricity, such as PG&E, purchase a certain percentage of electricity generated by Eligible Renewable Energy Resources (ERR). Originally, each utility was required to increase its total procurement of ERRs by at least one percent of annual retail sales per year so that 20 percent of its retail sales are supplied by ERRs by 2017.<sup>21</sup>

The State's Energy Action Plan (EAP) called for acceleration of this RPS goal to reach 20 percent by 2010. This was reiterated again in the Order Instituting Rulemaking issued on April 28, 2004, which encouraged the utilities to procure cost-effective renewable generation in excess of their RPS annual procurement targets, in order to make progress towards the goal expressed in the EAP. On September 26, 2006, Governor Schwarzenegger signed Senate Bill 107, which officially accelerates the State's RPS targets to 20 percent by 2010.<sup>22</sup>

Other benefits such as vector control and water quality improvements can result from improvements in the manure management system during the implementation of a digester project. Another benefit to anaerobic digesters is the reduction in odor and flies. It is one of the most appreciated benefits by the neighbors of farms with digesters.

Both projects clean and compress the methane gas to pipeline quality. This qualifies as a renewable natural gas (RNG) resource. PG&E is purchasing all the biogas produced by the two projects being considered and expects to have 14 percent of its energy from renewable sources that qualify under California’s Renewable Portfolio Standard (RPS) Program in 2008.

Under a long-term contract approved by the CPUC, Bioenergy Solutions will deliver up to three billion cubic feet of renewable natural gas a year, enough to meet the electricity needs of

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<sup>19</sup> From US Environmental Protection Agency’s AgSTAR website. ([www.epa.gov/agstar](http://www.epa.gov/agstar)).

<sup>20</sup> EPA/AgSTAR newsletter of November 2007, “Anaerobic Digesters Continue Growth in US Livestock Market.”

<sup>21</sup> California Public Utilities Commission, Energy Division, Final Resolution #E-4803.

<sup>22</sup> Ibid.

approximately 50,000 PG&E residential customers.<sup>23</sup> In a similar contract, Microgy plans on supplying approximately 8,000 million cubic feet of renewable natural gas to PG&E.<sup>24</sup>

**ISSUES WITH BIOGAS FROM ANIMAL WASTE:** The CPCFA commissioned a study in late 2007 to gauge the reaction of key environmental and environmental justice stakeholders. They were contacted and asked their thoughts if CPCFA were to provide tax-exempt bonds for anaerobic digestion projects. Key representatives interviewed for the report supported anaerobic digestion technology and felt it had a positive impact on reducing greenhouse gas emissions. However, the majority expressed concern that this technology would create an incentive for authorizing new Confined Animal Feeding Operations (CAFOs) in the Central Valley. Furthermore, it was felt that no one at the State level was addressing the real issue – the need to address all the issues posed by the growth and consolidation of the dairy industry in California.

The Sierra Club opposes the development of new CAFOs, and believing the problems of CAFOs will greatly outweigh the potential benefits of methane digesters.<sup>25</sup> The Sierra Club policy favors decreasing the amount of waste generated and that reuse and recovery facilities should not release hazardous substances or noxious odors. The Sierra Club of California believes that dairies have a manure problem with or without anaerobic digesters.<sup>26</sup>

Given the above, most agree that there are benefits to anaerobic digesters and the production of biogas from animal wastes. The Sierra Club said that anaerobic digesters are successful at eliminating some of the problems traditionally associated with CAFOs. Odor elimination and a separated effluent that is easier to transport and spread than raw manure are key benefits. Stabilization of pathogens and nutrients makes anaerobically digested effluent safer and less likely to damage surface water quality. Prevention of greenhouse gas emissions is another advantage. As better design and construction practices improve the performance of digesters, problems such as gas leaks and operational difficulties may decrease. Anaerobic digesters are useful in mitigating some of the environmental effects on existing CAFOs.<sup>27</sup>

The Sierra Club states that anaerobic digesters may be a good source of on-site energy; however, they ultimately do not offer very large potential as an energy source. The amount of energy EPA expects would be produced if a significant number of new digesters were installed in the United States is minimal. Solar energy, which has great potential to become a more significant source of energy in the United States, is even now at 300 times greater production than anaerobic digesters would be at their peak.<sup>28</sup>

While digesters are effective in reducing emissions, when biogas is burned in an engine to generate electricity it emits Nitrogen Oxides (NOx). NOx is an air pollutant and is one of the main ingredients involved in the formation of ground-level ozone and contributes to global warming.<sup>29</sup> Large electrical generation plants (such as PG&E's) must meet more stringent air

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<sup>23</sup> PG&E news releases dated March 4, 2008 and February 12, 2007.

<sup>24</sup> PG&E news release dated August 24, 2007.

<sup>25</sup> From, Sierra Club Guidance: Methane Digesters And Concentrated Animal Feeding Operation (CAFO) Waste, adopted October 2004.

<sup>26</sup> Per discussion with Sierra Club of California, 3/26/08.

<sup>27</sup> An Analysis of the Benefits of Farm-Scale Anaerobic Digesters in the United States, by the Sierra Club, September 2006, Rachel Saltzman.

<sup>28</sup> Ibid.

<sup>29</sup> "What are the Six Common Air Pollutants", <http://www.epa.gov/air/urbanair/nox/chf.html>

pollution standards and are much more efficient at utilizing RNG. The San Joaquin Valley Air Pollution Control District prefers that the gas is pipelined and used by PG&E because of the increased efficiency and reduced air pollution.

If tax-exempt bonds were eventually issued, all stakeholders agreed that the recipients of these public funds must have facilities that were “operated properly, inspected regularly, and enforced vigorously.” The determining factor on whether to provide tax-exempt bonds for any party was whether or not a project had an overarching public benefit.<sup>30</sup>

**CPCFA STATUTORY AUTHORITY:** In general, CPCFA’s statute permits financing of projects related to resource recovery and/or to reduce environmental pollution. Health & Safety Code Sections 44535 (a), 44535(b), and 44537.5 read, in part:

The authority may separately approve financing for projects, the purpose of which is to prevent, remediate, or reduce environmental pollution resulting from the disposal of solid, hazardous, or liquid waste.

The following projects shall be considered for financing:

- (1) Projects utilizing recognized resource recovery or energy conversion processes.
- (2) Projects utilizing new technologies or processes for resource recovery or energy conversion.
- (3) Projects utilizing technologies designed to reduce the level of pollutants found in water...
- (7) Projects for the disposal of agricultural wastes.

The authority shall provide the maximum opportunity for the use of the authority's financing by individuals, businesses engaged in agricultural operations, and small businesses or corporations by providing information, assistance, and coordination to facilitate financing for small projects and other financing that benefits the environment and the economy of the state, including financing for projects for the disposal of agricultural wastes, with special attention to the needs of businesses that do not meet standard commercial lending requirements but provide public benefits....

Staff discussions with bond counsel for the projects listed in this review appear to confirm both projects are solid waste disposal and would qualify under federal tax law. According to tax counsel, this type of project qualifies under federal tax law because cow manure is both a solid and a waste. Also, the manure has no value before going into the digester.

**CONSIDERATIONS FOR CPCFA:** There are several considerations with respect to financing projects using anaerobic digestion of animal wastes to process manure and other organic wastes and produce biogas as a fuel source for industry.

As pointed out above, projects involving dairies have drawn concern from the environmental and environmental justice communities. Past tax exempt financing of dairy related waste projects by CPCFA drew much scrutiny and concern, even leading to a temporary moratorium on financing such projects.

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<sup>30</sup> Central Valley Dairy Operations and Anaerobic Digestion as an Energy Source: Perspective from Central Valley Environmental and Environmental Justice Stakeholders. Report to CPCFA by Betsy Reifsnider, December 2007.

Greenhouse gas reduction and energy self reliance are becoming key issues facing California and the nation. Although the impact of anaerobic digesters on the total reduction of GHG may be relatively small compared to other sources of pollution, processing manure through anaerobic digestion has been identified as an important “early action” to address the climate change problem in California.

CPCFA should consider whether anaerobic digester projects provide a public benefit that aligns state policy, law and regulation.

**RECOMMENDATION:** Staff finds that there is evidence of pollution control benefits to be derived from tax-exempt financing of qualifying projects using anaerobic digestion technology to create biogas from manure. Therefore, staff recommends that the Authority direct staff to consider applications for tax-exempt financing of anaerobic digestion projects and to evaluate each application on its individual merits. Staff acknowledges that applications for anaerobic digestion projects will be evaluated on their individual public and pollution control benefits (including climate change, air quality and water quality), financing structure, and legal status. Applications for anaerobic digestion projects will be subject to the same degree of scrutiny by staff and by counsel, and subject to the same standards of documentation, as other applications received.