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LEGAL AND POLICY ISSUES RELATED TO ANAEROBIC DIGESTION AT UNITED STATES LIVESTOCK FACILITIES

JENNIFER C. FISER*

I. INTRODUCTION

The technology needed to convert manure into methane, which can then be used for energy, has been relatively well developed for several decades. While generating clean energy from livestock manure may seem like a perfect solution to several problems, actually putting this idea into practice requires overcoming significant hurdles. During the 1970s energy crisis, 141 anaerobic digesters were built at livestock facilities in the United States.¹ Unfortunately, those systems did not live up to expectations and, by the mid-1990s, 85% were no longer in use.² But, as of November 2010, 160 anaerobic digestion (“AD”) systems were operational on commercial U.S. farms,³ with strong growth in this area expected to continue.

Will AD succeed this time around? The answer may be “yes”, primarily because the reasons for its newfound popularity stem from a convergence of factors not present in the 1970s. Energy needs still play a role in the current promotion of AD technology, but it is not only AD’s promise of “cheap” energy that is the focus; anaerobic digestion’s status as “green” and renewable drives much of its demand in the current market. In addition, growing awareness of climate change has brought attention to agriculture’s contribution to it, and AD is a clearly established method of reducing greenhouse gas emissions from livestock production. Further, changes within the livestock industry have brought about new problems for and increased regulation of manure management. AD offers solutions to some of these environmental problems and can help achieve regulatory compliance. Despite these factors driving AD’s current success, some challenges still threaten its widespread adoption; however, these problems

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¹ David Riggle, *Anaerobic Digestion Gets New Life on Farms*, BIOCYCLE, Jan. 1997, at 74, available at http://www.epa.org/agstar/documents/Riggle_11_26_07.pdf.

² *Id.*

³ AgSTAR, *Operating Anaerobic Digester Projects*, <http://www.epa.gov/agstar/projects/index.html> (last updated Nov. 17, 2010).

may be overcome through collaboration among agricultural producers, environmental regulators, and other involved parties.

Due to the rising importance of this process, this Article will first examine exactly how AD technology works and how it benefits the farmers who use it. It will then examine the policies driving the adoption of AD technology, both during its initial prominence in the 1970s and early 1980s and those that continue to drive its current resurgence. It will then consider the remaining challenges to the widespread use of AD. Finally, it will explain how and why U.S. policy should support AD's success.

II. ANAEROBIC DIGESTION OF LIVESTOCK WASTES

Anaerobic digestion is a naturally occurring process driven by a combination of several types of bacteria.⁴ The reactions involved are similar to the reactions carried out by the specialized bacteria living in a cow's rumen, the first and largest compartment in its stomach.⁵ The bacteria needed to complete the digestion process are naturally present in manure,⁶ and the types present will depend on the composition of the digested waste.⁷ Different bacteria use a variety of biochemical reactions break down the chemical compounds in the waste.⁸

Anaerobic digestion facilities use the natural processes carried out by these bacteria to generate energy. Three types of AD facilities are commonly seen on U.S. farms: covered lagoon, complete mix, and plug-flow.⁹ The type of facility a farmer chooses depends on several factors, including available financing, climate, and the concentration of solids in the manure.¹⁰ A covered lagoon digester consists of a lagoon filled with liquid dairy or swine manure typically less than 3% solids, with a cover to trap the gas created.¹¹ The amount of gas generated depends on the ambient temperature. While this type of system is not cost-effective for energy production in colder climates, covered lagoons can still be used for methane capture and odor control in those regions.¹²

The second type of AD facility, a complete mix digester, consists of a tank, either above or below ground, that holds slurries of dairy or swine

⁴ Peter N. Hobson & Andrew D. Wheatley, *Anaerobic Digestion: Modern Theory and Practice* 7, 11 (1993).

⁵ *Id.* at 8.

⁶ *Id.* at 11.

⁷ *Id.* at 9.

⁸ *See id.* at 9, 26-47.

⁹ *Id.* at 6-7.

¹⁰ *See* Nelson & Lamb, *The Minn. Project, Final Report: Haubenschild Farms Anaerobic Digester 5-6* (2002), available at <http://www.mnproject.org/pdf/Haubyrptupdated.pdf>.

¹¹ AGSTAR, *AGSTAR HANDBOOK 1-2, Exhibit 1-1* (2d ed.), available at <http://www.epa.gov/agstar/tools/project-dev/handbook.html>.

¹² *See* NELSON & LAMB, *supra* note 10, at 6.

manure that are 3% -10% solids.¹³ The tank is heated and a mixer is used to keep the solids suspended in the waste.¹⁴

Finally, a plug-flow digester consists of a heated in-ground tank that receives dairy manure with 11% -13% solids.¹⁵ Because swine manure lacks fiber, it is not appropriate for use with a plug-flow digester.¹⁶ While these three are the most popular today, it is important to note that several other digester designs exist, and newer types of digesters may become common in the future as research and funding for AD projects expands.¹⁷

After digestion, the AD-produced methane is collected and can then be flared, used to generate electricity,¹⁸ or used as a natural gas substitute.¹⁹ The installation of a generator to convert the biogas into electricity is an additional cost, but one that is economical because it enables the farmer to generate power for either his own on-farm use or for sale to the utility grid.²⁰ Upgrade of utility lines and other equipment is typically necessary, and farmers are generally expected to pay for related expenses.²¹ Use of methane as a natural gas substitute is less common, and further processing is necessary to remove contaminants in order to have a pure source of energy suitable for use as a natural gas replacement.²² Other uses for methane are also being developed, potentially including car fuel.²³

Further treatment of the digested waste may also be desirable to some farmers who own AD systems. Of these farmers, some land-apply the end product of digestion (which is almost odorless) without further processing, while others invest in additional equipment to separate the liquid portions from the solid portions.²⁴ The liquid portion can be land-applied as a nutrient-rich liquid fertilizer and the solid used as animal

¹³ *Id.*

¹⁴ *Id.*

¹⁵ See AGSTAR, *supra* note 11, at 1-3.

¹⁶ *Id.*

¹⁷ NELSON & LAMB, *supra* note 10, at 8. While energy production is a straightforward process, selling the excess energy to a utility company can be far more complicated, and can entail heavy burdens on the farmer. See *infra* Part V.C.1.

¹⁸ See Phillip D. Lusk, *Farm-based Digester Conference Highlights*, BIOCYCLE, Jan. 2008, at 45, 46.

¹⁹ See HOBSON & WHEATLEY, *supra* note 4, at 240-42.

²⁰ See AGSTAR, *supra* note 11, at 2-5, 3-1. Waste heat created by the generator can also be used as an on-farm energy source, typically as a source of heat for the digester itself or for water or space heating. See *id.* at 3-3.

²¹ *Infra* Part V.C.1.

²² See generally Nicolas Abatzoglou & Steven Boivin, *A Review of Biogas Purification Processes*, 3 BIOFUELS, BIOPRODUCTS AND BIOREFINING 42 (2009) (discussing that the existence of natural contaminants in biogas would require such to be purified upstream before it can be used as a natural gas substitute).

²³ *Research and Development: Methane-Powered Vehicles*, AGSTAR DIGEST, Summer 2007, <http://www.epa.gov/agstar/news-events/digest/2007summer.html> (last updated Dec. 20, 2010).

²⁴ See John F. Katers et al., *Solids Separation of Dairy Manure*, BIOCYCLE, Dec. 2008, at 51.

bedding or a soil amendment.²⁵ Not only can on-farm use of these products result in significant savings for a farmer, but their sale can moderately increase a farmer's revenue.²⁶

While AD is not a treatment option for *all* farms, it has many potential benefits in certain situations.²⁷ The most obvious benefit is the capture of methane, a gas that has twenty times the impact of carbon dioxide on global warming.²⁸ AD can also reduce nitrous oxide emissions due to oxidation of that gas during combustion.²⁹ If an AD facility produces excess energy that is sold back to the grid, that energy displaces demand for energy from fossil fuels, which also reduces carbon dioxide emissions.³⁰ Odor, primarily caused by volatile organic acids that are broken down during digestion, may also be reduced by AD treatment.³¹ When the digester functions at a high enough temperature, most pathogens and weed seeds are destroyed during digestion, making the resulting effluent more suitable as a fertilizer or soil conditioner.³² The effluent is also more suitable as a fertilizer because the process converts the nitrogen to a form more readily used by plants.³³ These benefits can make AD a worthwhile investment for some farmers, despite the costs and complications involved in adopting AD technology.

²⁵ *Id.* at 54; Michigan Biomass Energy Program, *Anaerobic Digester FAQs*, Sept. 2005, available at http://www.michigan.gov/documents/anaerobic_digester_FAQs_2005_137431_7.pdf.

²⁶ *See id.*

²⁷ *See* AGSTAR *supra* note 11, at 1-1.

²⁸ Executive Summary, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2008, ENVIRONMENTAL PROTECTION AGENCY (EPA), 10 (Apr. 2010) available at http://epa.gov/climatechange/emissions/downloads10/US-GHG-Inventory-2010_ExecutiveSummary.pdf. [hereinafter "EPA INVENTORY"]. Combustion of methane does produce carbon dioxide, but a net reduction of up to approximately 90 percent of greenhouse gas emissions can be achieved with this process (based on carbon dioxide equivalents). RAYMOND J. KOPP & WILLIAM A. PIZER, RESOURCES FOR THE FUTURE, ASSESSING U.S. CLIMATE POLICY OPTIONS 178 (2007).

²⁹ EPA, Development Document for the Final Revisions to the National Pollutant Discharge Elimination System Regulation and the Effluent Guidelines for Concentrated Animal Feeding Operations 13-13 (2002), available at http://www.epa.gov/npdes/pubs/cafo_dev_doc_p5.pdf. While the amount nitrous oxide emitted from livestock manure is small, reduction can still be beneficial because of its large impact on global warming. Amanda D. Cuellar & Michael E. Webber, *Cow Power: The Energy and Emissions Benefits of Converting Manure to Biogas*, 3 *Envtl. Res. Letters* 1 (2008). Nitrous oxide has 300 times the impact of carbon dioxide on global warming. EPA Inventory, *supra* note 28, at 10.

³⁰ Recommendations for the Development of Agricultural Sector Carbon Offsets in Washington State, 2008 WASHINGTON ST., AGRIC. SECTOR CARBON MARKET WORKGROUP, 25 (Oct. 2008), available at http://www.ecy.wa.gov/climatechange/2008FAdocs/Ag_Offset_Recc_Pkg_FINAL.pdf.

³¹ AGSTAR, *supra* note 11, at 1-5.

³² Reader's Q&A: Digested Versus Raw Manure, BIOCYCLE, Dec. 2003, at 14.

³³ *Id.*

III. THE 1970S ENERGY CRISIS: ANAEROBIC DIGESTION'S RISE AND FALL

In 1973, the United States faced a serious energy crisis, and due to predicted fuel shortages at a time when growing crops demanded vast amounts of energy, there were even concerns about the nation's food security.³⁴ The United States became determined to develop alternative energy sources, and former President Richard Nixon promised that, "in the year 1980, the United States will not be dependent on any other country for the energy we need to provide our jobs, to heat our homes, and to keep transportation moving."³⁵ AD companies worked hard to convince farmers that their manure was "gold" and "the future energy source of America."³⁶ Interest in anaerobic digestion on U.S. farms surged beginning in the 1970s, and about 140 biogas systems were built.³⁷ Seventy-one of those systems were built at commercial livestock production facilities, with the rest built at research facilities.³⁸ Further encouragement came from the 1978 enactment of the Public Utility Regulatory Policies Act ("PURPA"), which mandated that utility companies buy energy from qualifying facilities, including biomass-powered systems, at rates that were "just and reasonable to the electric consumers of the electric utility and in the public interest" and did not "discriminate against . . . small power producers."³⁹

Even as AD was being promoted as a way to generate cheap excess energy, there were indications that it was not a viable option for most farms. In 1978, the Economics, Statistics, and Cooperatives Service, a former division of the U.S. Department of Agriculture ("USDA"), produced a report entitled, *An Assessment of Anaerobic Digestion in U.S. Agriculture*, which concluded that "widespread application of anaerobic digestion technology in American agriculture does not now, nor in the foreseeable future, appear economically feasible."⁴⁰ The report noted several technical and economic factors preventing adoption of AD at most facilities, including limitations related to economies of scale, large capital requirements, inability to supply a substantial amount of energy, and the

³⁴ See generally Energy Crisis and Its Effect on Agriculture: Hearing on H.D. 97-546 Before the H. Comm. on Agriculture, 93d Cong. (1973).

³⁵ Donald L. Bartlett et al., *The U.S. is Running Out of Energy*, TIME, July 21, 2003, at 36.

³⁶ Nora Goldstein, *Historical Perspective: Farm Digesters*, BIOCYCLE, Feb. 2009, at 32 (quoting Fred Roland, former partner in Sheaffer & Roland, Inc., a company that built ADs during the 1970s).

³⁷ AGSTAR, *supra* note 11, at 1-5.

³⁸ *Id.*; Richard Mattocks & Richard Wilson, *Latest Trends in Anaerobic Digestion in North America*, BIOCYCLE, Feb. 2005, at 61.

³⁹ 16 U.S.C. § 824a-3(b) (2008); see Michael D. Hornstein & J.S. Gebhart Stoermer, *The Energy Policy Act of 2005: PURPA Reform, the Amendments and Their Implications*, 25 ENERGY L.J. 27 (2006).

⁴⁰ Ted Thornton, U.S. Dep't of Agric., No. ESCS-06, *An Assessment of Anaerobic Digestion in U.S. Agriculture*, at v (1978).

time and effort required to maintain the systems.⁴¹ While the report found some potential for use of AD at large livestock facilities, its overall response to the value of AD to agriculture was unenthusiastic.⁴² The report also found that even large increases in the price of natural gas would probably not result in economically competitive prices for biogas, and that AD held “little promise for making a significant contribution to the Nation’s overall energy needs.”⁴³

The push for AD in the United States came to a halt in the 1980s for several reasons. The first reason was the high failure rate of the facilities built in the 1970s and 1980s, which was caused by several factors including lack of operator skills, poor choice of design and equipment, and lack of maintenance.⁴⁴ Additionally, demand for digester-produced energy disappeared once high energy prices dropped and oil scarcity was forgotten.⁴⁵ A reduction in the price paid for renewable energy under PURPA and frustration with utility companies also contributed to AD’s demise, as farmers were unable to sell excess power to utility companies at a fair price.⁴⁶

Many of these problems were not unique to AD, and renewable energy, in general, suffered from declining public interest once the energy crisis passed.⁴⁷ The implementation of alternative energy systems had proven to be more complicated and less reliable than proponents had hoped.⁴⁸ The challenges had increased the costs of alternative energy projects, and public interest in renewable energy died off without the motivation of clear economic gain; environmental benefits were simply not enough to incentivize a continued push for AD at that time.⁴⁹ The dismal success rate turned most people involved, including farmers, regulators, banks, and utility companies, against the use of AD.⁵⁰ As a result, approximately 85% of AD facilities built in the 1970s either failed or were abandoned.⁵¹ Construction of new AD facilities in the United States was almost non-existent from the mid-1980s until the early 1990s.⁵²

⁴¹ *Id.* at 33-36.

⁴² *See id.*

⁴³ *Id.* at 32-33, 36.

⁴⁴ AGSTAR, *supra* note 11, at 1-6. An additional problem was the lack of screening of grant applicants, allowing federal money to go to projects that were not suitable for the specific farm or economically feasible. Riggle, *supra* note 1, at 74.

⁴⁵ HOBSON & WHEATLEY, *supra* note 4, at v.

⁴⁶ Riggle, *supra* note 1, at 74; *see* HOBSON & WHEATLEY, *supra* note 4, at 2.

⁴⁷ HOBSON & WHEATLEY, *supra* note 4, at 1.

⁴⁸ *Id.*

⁴⁹ *See id.*

⁵⁰ Mattocks & Wilson, *supra* note 38, at 61.; *see also* Kevin Porter et al., Berkeley Lab & the Clean Energy Group, Two Different Approaches to Funding Farm-Based Biogas Projects in Wisconsin and California 2 (2002).

⁵¹ *Id.*

⁵² *See id.* Although interest in the U.S. died off, other countries continued to explore the potential of AD. Germany is the leader in AD use in the EU; it currently has approximately 1,900 farm

IV. ANAEROBIC DIGESTION MAKES A COMEBACK: A SOLUTION TO NEW PROBLEMS

During the 1990s, new challenges arose for the livestock industry and U.S. society as a whole, and AD's utility was re-evaluated. AD once again appeared to be at least a partial solution to some of our nation's problems. In 1994, the U.S. Environmental Protection Agency ("EPA"), USDA, and U.S. Department of Energy ("DOE") jointly founded the AgSTAR program to develop and promote AD technology on U.S. farms.⁵³ AgSTAR began constructing demonstration facilities to prove that AD could work, and their success began to rebuild AD's image within the agriculture industry and gain attention from groups outside the industry as well.⁵⁴ Instead of viewing it as simply a source of cheap energy, producers began to envision AD as an integral part of a comprehensive plan for responsible livestock production and overall environmental responsibility, providing previously unappreciated benefits.

A. Global Warming and Demand for Renewable Energy

As in the 1970s, one reason for current interest in AD use at livestock facilities is energy. The difference, however, is that the nation's attitude toward energy has changed significantly since the previous crisis. While rising energy prices are still a factor, a new emphasis on renewable sources of energy has emerged. This shift has been driven by our relatively new knowledge of climate change.⁵⁵ In the early 1970s, climate change was in no way associated with AD use; AD was promoted simply as a cheap source of energy, with environmentalists even sometimes accused of overreaching and *worsening* the energy crisis.⁵⁶

Today, global warming is a serious concern. The United States ratified the United Nations Framework Convention on Climate Change in 1992,⁵⁷ and has faced increasing pressure to take further action in more recent years.⁵⁸ The electric power industry was the largest contributor of greenhouse gas emissions in the United States in 2007 and was responsible

biogas plants in use. AD-Nett (the European Anaerobic Digestion Network), <http://www.ad-nett.net/index.html> (follow "EU-Statistics" hyperlink; then follow "Farm Biogas Plants in EU" hyperlink) last updated Apr. 6, 2005).

⁵³ See Goldstein, *supra* note 36, at 32.

⁵⁴ Mattocks & Wilson, *supra* note 38, at 61-62.

⁵⁵ Riggle, *supra* note 1, at 74.

⁵⁶ See Energy Crisis and Its Effect on Agriculture, *supra* note 34, at 51-52.

⁵⁷ EPA INVENTORY, *supra* note 28, at ES-1.

⁵⁸ Gray & Mason, *Copenhagen climate change: 'US should spend as much on global warming as war'*, THE TELEGRAPH, July 24, 2011, available at <http://www.telegraph.co.uk/earth/copenhagen-climate-change-confe/6781260/Copenhagen-climate-change-US-should-spend-as-much-on-global-warming-as-war.html>.

for almost five times the amount of greenhouse gas emissions generated by the entire agriculture industry.⁵⁹ As a result, regulatory actions outside of the livestock industry encourage the use of AD.

Although energy prices continue to rise and fall, concerns related to global warming are constant and therefore may retain our nation's attention and create long-lasting changes in our energy policy.⁶⁰ One of the primary state actions helping to drive demand for biogas and renewable energy in general is the adoption of a renewable energy portfolio standard ("RPS") or a renewable energy portfolio goal ("RPG").⁶¹ By September 2010, thirty-six states and the District of Columbia had adopted either an RPS or an RPG.⁶² California, in particular, has taken several actions, including passage of a Global Warming Solutions Act of 2006, "the first enforceable state-wide program in the U.S. to cap all GHG emissions from major industries that includes penalties for non-compliance."⁶³ In addition, California's Executive Order S-06-06 sets both short- and long-term biofuel targets for state production.⁶⁴ None of these goals can be met without a sufficient supply of alternative energy. One drawback to using measures such as an RPS to drive AD development is their potential to favor the alternative energy with the lowest cost unless specific technology targets are also used.⁶⁵ AD facilities remain expensive, and other alternative energy approaches may be more competitively priced.

In 2009, AD of livestock waste produced 374 million kilowatt-hours (kWh) of power.⁶⁶ While the network of AD systems is often viewed as a rather small contributor to renewable energy, the U.S. livestock sector has the potential to support an estimated 8,241 AD systems, producing over 13 million MWh of electricity per year and displacing 1,667 MWh of fossil

⁵⁹ See *id.* at ES-15.

⁶⁰ See Jeff Johnson, *Energy Crisis Déjà Vu, or Not*, CHEM. & ENG'G NEWS, Nov. 10, 2008, at 32-33, available at <http://pubs.acs.org/cen/government/86/8645gov1.html>.

⁶¹ A renewable portfolio standard requires that a minimum percentage of power must be obtained from renewable energy resources. A renewable energy goal is a nonbinding commitment to adopt renewable energy. U.S. Dep't of Energy, *States with Renewable Portfolio Standards*, http://apps1.eere.energy.gov/states/maps/renewable_portfolio_states.cfm.

⁶² EPA, *State Renewable Portfolio Standards (RPS)*, <http://www.epa.gov/lmop/publications-tools/funding-guide/renewable.html> (last updated Jan. 6, 2011).

⁶³ Pew Center on Global Climate Change, *California Global Warming Solutions Act of 2006*, http://www.pewclimate.org/what_s_being_done/in_the_states/ab32. The Global Warming Solutions Act "requires the State Air Resources Board to establish a program for statewide greenhouse gas emissions reporting and to monitor and enforce compliance with this program" and "authorizes the state board to adopt market-based compliance mechanisms including cap-and-trade, and allows a one-year extension of the targets under extraordinary circumstances." *Id.*

⁶⁴ *Id.*

⁶⁵ See generally Xiaodong Wang, *Legal and Policy Frameworks for Renewable Energy to Mitigate Climate Change*, 7 SUSTAINABLE DEV. L. & POL'Y 17, 18 (2007).

⁶⁶ AgSTAR, *Anaerobic Digesters Continue to Grow in the U.S. Livestock Market* (May 2010), available at http://www.epa.gov/agstar/documents/2010_digester_update.pdf.

fuel energy per year.⁶⁷ Assuming an average of ten cents per kWh (the average price in 2009), energy generated could be worth over \$1.3 billion per year in avoided energy costs.⁶⁸ While this sounds impressive, one study found that the energy production from the AD of all animal manure in the United States would yield only 2.4% ± 0.6% of U.S. energy needs per year and displace 3.9% ± 2.3% of greenhouse gas emissions from traditional electricity production.⁶⁹ Despite the fact that AD is likely to only meet a small portion of U.S. energy demands, it is still being pursued as one part of a solution to the challenges of global warming and renewable energy production.

B. Transformation of the Livestock Industry and Increasing Regulation

While AD's potential to displace traditional sources of electricity may be limited, our growing need for clean energy is not the only change driving the push for adoption of AD—the livestock industry has changed. The livestock industry's transformation over the past few decades has been dramatic and is encouraging the AD's adoption in several ways. Livestock production has become increasingly intensified, with more animals raised at fewer farms. For example, the number of dairies in California dropped from about 4,000 in 1992 to 2,100 in 2004, while the actual number of dairy cows increased by approximately 500,000, and the average number at a single facility increased from 370 to over 800.⁷⁰ This trend toward intensification is likely to continue and is not only present in the United States. The Food and Agriculture Organization of the United Nations' ("FAO") Committee on Agriculture has estimated that global meat production will increase to 465 million metric tons by 2050, over twice the amount produced in 1999.⁷¹ The FAO expects most of the increase in demand to come from developing countries and most of the increase in production to come from intensive production systems.⁷² One inevitable consequence of increased meat production is the production of more livestock excrement. This, in turn, makes the responsible management of that waste even more important.

⁶⁷ EPA, MARKET OPPORTUNITIES FOR BIOGAS RECOVERY SYSTEMS AT U.S. LIVESTOCK FACILITIES 1, 5 (Dec. 2010), available at http://www.epa.gov/agstar/documents/biogas_recovery_systems_screenres.pdf.

⁶⁸ *Id.* at 5.

⁶⁹ Amanda D. Cuellar & Michael E. Webber, *Cow Power: The Energy and Emissions Benefits of Converting Manure to Biogas*, 3 ENVTL. RES. LETTERS 2, 6 (2008).

⁷⁰ Jih-Shyang Shih et al., *Air Emissions of Ammonia and Methane from Livestock Operations, Valuation and Policy Options 2* (2006), available at <http://www.rff.org/Documents/RFF-DP-06-11.pdf>.

⁷¹ FAO, MANAGING LIVESTOCK-ENVIRONMENT INTERACTIONS 1 (2007), available at <ftp://ftp.fao.org/docrep/fao/meeting/011/j9421e.pdf>.

⁷² *Id.*

As livestock production has begun to intensify, consumers have started to expect more responsibility from agriculture. Products on store shelves boast of being sustainable and “green.” The public is now more aware of the environmental effects of agricultural production.⁷³ In addition to simply having more available information about the environmental consequences, the public is learning about some of the less pleasant aspects of that process firsthand as residential development expands into traditionally rural areas.⁷⁴ This expansion has set the stage for conflict between livestock producers and other residents that result in increasing regulation and litigation. Problems generally fall into three areas: odor, air quality, and water quality. AD treatment has the potential to help manage all three of these areas.

Livestock manure’s foul odor can be a problem, and it comes as no surprise that people living near livestock facilities are intolerant of the smell and increasingly taking action to control it. Regulation of odor has been carried out in several ways. For instance, Pennsylvania has adopted a right-to-farm law that protects livestock facilities from nuisance lawsuits if they develop approved nutrient and odor management plans.⁷⁵ Other states directly regulate odor. For example, Colorado’s Amendment 14, passed by voters in 1998, strengthened the regulation of housed commercial swine feeding operations, requiring the use of covered “wastewater vessels and impoundments” to “capture, recover, incinerate, or otherwise manage odorous gasses to minimize, to the greatest extent practicable, the emission of such gases into the atmosphere.”⁷⁶ It also requires operations to minimize off-site odors.⁷⁷ AD has also provided a valuable approach to government compliance for some operations, such as the Colorado Pork facility near Lamar, Colorado. This facility has served as a demonstration

⁷³ See NATURAL RES. CONSERVATION SERV., NATIONAL ANIMAL AGRICULTURE CONSERVATION FRAMEWORK 1 (2003), available at http://www.nrcs.usda.gov/Technical/af/pdf/NAACF_Final.pdf.

⁷⁴ See *id.* at 7.

⁷⁵ Terrence J. Centner, *Nuisances from Animal Feeding Operations: Reconciling Agricultural Production and Neighboring Property Rights*, 11 DRAKE J. AGRIC. L. 5, 16 (2006) (discussing 3 PA. CONS. STAT. ANN. § 954 (Supp. 2005)). Facilities large enough to be designated as CAFOs are required to develop odor plans, while smaller facilities may voluntarily submit plans for approval. 3 PA. CONS. STAT. ANN. § 509 (Supp. 2005).

⁷⁶ COLO. AMENDMENT 14 (1998) (codified at COLO. REV. STAT. § 25-7-138 (2008)), available at <http://www.animallaw.info/statutes/stusco1998ballotamend14commercialhog.htm>. A “housed commercial swine feeding operation” is defined as “a housed feeding operation that is capable of housing eight hundred thousand pounds or more of live animal weight of swine at any one time or is deemed a commercial operation under local zoning or land use regulations.” *Id.* at (2)(a). Eight hundred thousand pounds of live animal weight would correspond to approximately 2,000 to 5,000 animals. Analysis of Amendment 14, Colo. Gen. Assembly, Legis. Council, available at <http://www.animallaw.info/statutes/stusco1998ballotamend14commercialhog.htm>.

⁷⁷ COLO. AMENDMENT 14, *supra* note 76.

of AD's potential to meet the Colorado's Amendment 14 requirements.⁷⁸ North Carolina took a similar step and banned the issuance of permits for the construction, operation, or expansion of swine lagoons in 2007 if the lagoon was considered the primary treatment method.⁷⁹ Producers must now construct systems that meet certain requirements, and anaerobic digesters constitute a potential option for compliance.⁸⁰ Even in the absence of direct regulation, AD may help livestock producers avoid nuisance lawsuits from neighbors over odors.⁸¹

In addition to problems with odor, increased attention has been directed at air pollution from livestock since the early 1990s.⁸² In response to a report by the National Research Council and growing concern about air pollution from livestock facilities,⁸³ the EPA developed the Air Compliance Agreement, a voluntary consent agreement with the objective of allowing the EPA to collect data while providing a limited safe harbor for participating producers.⁸⁴ Under the consent agreement, facilities that installed waste-to-energy systems were allowed an additional 180 days to apply for Clean Air Act permits and make and to make hazardous release notifications required by an EPA Final Order issued on January 31, 2005.⁸⁵ While the Air Compliance Agreement does not require producers to reduce emissions, it is a signal that the effects of livestock production on air quality are no longer being ignored.⁸⁶

This increased attention comes at a time when the EPA is already re-examining its approach to greenhouse gases. Global warming is an increasing concern; global levels of methane and nitrous oxide are estimated to have increased by 143% and 18%, respectively, since the beginning of the pre-industrial era in 1750.⁸⁷ Between 1990 and 2008, the

⁷⁸ John H. Martin, Eastern Res. Group, *An Assessment of the Performance of the Colorado Pork, LLC. Anaerobic Digester and Biogas Utilization System* (Mar. 2003), http://www.epa.gov/agstar/documents/colorado_pork.pdf; Intermountain CHP Application Ctr., *Project Profile: Colorado Pork 115-kW Renewable CHP Application* (Dec. 2004), http://www.chpcentermw.org/rac_profiles/intermountain/Colorado_Pork_Project_Profile.pdf.

⁷⁹ N.C. GEN. STAT. § 143-215.10I (2009).

⁸⁰ *Id.*; *State Policy Updates*, ONLINE AGSTAR DIGEST, Fall 2007, <http://www.epa.gov/agstar/news-events/digest/2007fall.html#ten> (last updated Dec. 20, 2010).

⁸¹ NELSON & LAMB, *supra* note 10, at 27.

⁸² Jody M. Endres & Margaret Rosso Grossman, *Air Emissions from Animal Feeding Operations: Can State Rules Help?*, 13 PENN ST. ENVTL. L. REV. 1, 3-4 (2006).

⁸³ Nat'l Res. Council, *Air Emissions from Animal Feeding Operations: Current Knowledge, Future Needs* (2003), http://www.epa.gov/ttn/chief/ap42/ch09/related/nrcanimalfeed_dec2002.pdf.

⁸⁴ *See* Animal Feeding Operations Consent Agreement and Final Order, 70 Fed. Reg. 4958 (Jan. 31, 2005); *see also* Claudia Copeland, *CRS Report for Congress: Air Quality Issues and Animal Agriculture: EPA's Air Compliance Agreement* (2008), available at <http://www.nationalaglawcenter.org/assets/crs/RL32947.pdf>.

⁸⁵ Animal Feeding Operations Consent Agreement and Final Order, 70 Fed. Reg. 4958, 4964-65 (Jan. 31, 2005).

⁸⁶ *See* Endres & Grossman, *supra* note 82, at 5.

⁸⁷ EPA INVENTORY, *supra* note 28, at 1-4.

United State's emissions of all greenhouse gases combined rose by 14%.⁸⁸ During that period, U.S. emissions of methane from manure management increased by approximately 54%, and emissions of nitrous oxide from manure management increased by approximately 21%.⁸⁹

The EPA published a final rule in 2009 requiring mandatory reporting of greenhouse gases, including methane and nitrous oxide.⁹⁰ This rule only applies to livestock facilities that emit at least 25,000 metric tons of greenhouse gases (measured in carbon dioxide equivalents) per year, and the EPA expects 85 to 95 of the largest livestock facilities to fall into that category.⁹¹ The goal of the mandatory reporting program is to provide information for the development of a national climate policy, and it allegedly is not intended to be a step toward regulation of these emissions.⁹² Methane emissions are not regulated by the EPA; instead, the EPA promotes voluntary reductions through several programs, including AgSTAR.⁹³ It seems likely, however, that the scrutiny of greenhouse gas emissions will only increase as our climate policy continues to evolve.

The need for more stringent water quality regulation has also played a role in the public's renewed interest in AD. Under the Clean Water Act ("CWA"), Concentrated Animal Feeding Operations ("CAFOs") are treated as point sources of pollution.⁹⁴ Because limitations have been placed on the discharge of manure into water sources, CAFOs have been forced to use containment methods like storage lagoons to hold the waste.⁹⁵

⁸⁸ *Id.* at ES-3.

⁸⁹ *See id.* at Table 2-1, ES-9, 2-4. The increase in methane is primarily attributable to a shift towards liquid manure management systems in concentrated swine and dairy facilities, which result in greater methane emissions. *Id.* at 6-7. In 2007, manure management was the fifth largest contributor of methane emissions and nitrous oxide emissions in the U.S. *Id.* at Table ES-2. Enteric fermentation, which occurs within an animal's digestive tract as food is broken down, is currently the greatest contributor of methane emissions in the U.S. *Id.* at Fig. ES-8. Emissions from enteric fermentation are not included in estimates from manure management.

⁹⁰ 40 C.F.R. §§ 86, 87, 89 (2009). The EPA was directed to engage in this rulemaking under the Consolidated Appropriations Act, 2008, H.R. 2764, 110th Cong. (2008). For more information, see <http://epa.gov/climatechange/emissions/ghgrulemaking.html> (last visited Jan. 31, 2011).

⁹¹ EPA, GUIDE FOR THE AGRICULTURE AND LIVESTOCK SECTORS, PROPOSED RULE: MANDATORY REPORTING OF GREENHOUSE GASES 1-2 (2009), available at <http://www.epa.gov/climatechange/emissions/downloads/GuideAgricultureLivestockSectors.pdf>. The estimated cost to comply with the reporting requirements is \$900 per facility. *Id.* at 3.

⁹² Sally Shaver, *Federal Air Quality Regulations and Update on the National Air Emissions Monitoring Study*, EPA, 22:40-23:12 (July 18, 2008), http://www.extension.org/pages/Federal_Air_Quality_Regulations_and_Update_on_the_National_Air_Emissions_Monitoring_Study (last updated Aug. 30, 2010).

⁹³ EPA, *Methane Voluntary Programs*, <http://www.epa.gov/methane/voluntary.html> (last updated Jun. 22, 2010). EPA also administers the Coalbed Methane Outreach Program, the Natural Gas STAR Program, and the Landfill Methane Outreach Program. *See id.*

⁹⁴ 40 C.F.R. § 122.23 (2008).

⁹⁵ Donald L. Van Dyne and J. Alan Weber, ERS, *Biogas Production from Animal Manures: What Is the Potential?* INDUSTRIAL USES OF AGRICULTURAL MATERIALS SITUATION AND OUTLOOK REPORT, UNITED STATES DEPARTMENT OF AGRICULTURE, 21 (4th ed. 1994), available at <http://www.ers.usda.gov/publications/IUS4/ius4.pdf>.

The CWA reports numerous undeniably positive results for water quality; however, the storage systems adopted by many livestock facilities to prevent discharges of manure have actually *exacerbated* the problem of methane emissions.⁹⁶ The shift toward larger facilities creates a greater need for AD, because it results in an increase in the management of manure as a liquid which must be stored in holding tanks and lagoons. This type of storage increases the amount of methane produced.⁹⁷ Concentration of animals also makes manure collection easier, which facilitates the use of AD.⁹⁸

AD also plays an important role in complying with nutrient management plans required for CAFOs under the National Pollution Discharge Elimination System.⁹⁹ AD of livestock manure neither makes the manure disappear, nor removes any nutrients; therefore, its usefulness in improving water quality appears limited at first glance. Its true value lies in that it may be used as a part of a CAFO's nutrient management plan.¹⁰⁰ Yet another benefit of AD is that it kills most pathogens present in the manure,¹⁰¹ making the effluent safer even if runoff does occur.

The simple fear of additional regulation could also encourage adoption of AD by more livestock farmers. Bruce Knight, former Chief of the Natural Resources Conservation Service, has said:

Regulation is not the best scenario because it can have unintended consequences: compliance raises the cost of production; production moves state-to-state, region-to-region, or country-to-country to avoid these costs; geographic areas with lots of regulation lose economically, the environment loses because production takes place in localities with lower standards.¹⁰²

Voluntary use of AD has been proposed as a part of the solution to the problem of increasing regulation.¹⁰³ The decrease in pressure to regulate agriculture, reduction of greenhouse gas emissions, production of renewable energy, and improvements to odor, air quality, and water quality

⁹⁶ *Id.*

⁹⁷ *Id.* Manure that is handled as a dry material or deposited in the field is generally not subjected to anaerobic conditions, which are necessary for methane production to occur. *Id.*

⁹⁸ Identification of Non-Hazardous Materials That Are Solid Waste, 74 Fed. Reg. 41, 48 (Jan. 2, 2009).

⁹⁹ 40 C.F.R. § 122.23(a), (h) (2008).

¹⁰⁰ Riggle, *supra* note 1, at 76. For example, anaerobic digestion was approved as an option for nutrient management practice in New York in 1996. *Id.*

¹⁰¹ Reader's Q&A: Digested Versus Raw Manure, BIOCYCLE, Dec. 2003, at 14.

¹⁰² Bruce I. Knight, former Chief, Natural Res. Conservation Serv., Remarks at "Anaerobic Digester Technology Applications in Animal Agriculture—A National Summit" (June 3, 2003), available at <http://www.nrcs.usda.gov/news/speeches03/knight.manuremanagement.html>.

¹⁰³ See *id.*; NELSON & LAMB, *supra* note 10, at 29. Voluntary adoption of environmental practices by agricultural producers is strongly encouraged by agencies. The Environmental Quality Incentives Program (EQIP), which provides funding for some AD projects, strives both to help producers comply with applicable regulations, and to encourage producers to take voluntary actions so that regulatory action is unnecessary. NRCS, NATIONAL ANIMAL AGRICULTURE CONSERVATION FRAMEWORK 7 (2003).

provide strong incentives for farmers to adopt AD systems; however, the challenges involved in using AD can outweigh these benefits.

V. REMAINING CHALLENGES AND POTENTIAL SOLUTIONS

A. Cost and Financing

Despite federal and state support for AD, its cost is a major deterrent for many producers.¹⁰⁴ The cost of constructing an AD facility for a dairy farm handling waste only from its own operations can cost between \$1 million and \$1.5 million.¹⁰⁵ For many producers, building an AD facility is still not a possibility.¹⁰⁶ Many projects have been completed only with the help of substantial federal and/or state financial assistance or the creation of new models of ownership that lighten the producer's financial burden.

1. Federal and State Incentives

In recent years, the federal government has taken an active role in promoting alternative sources of energy. USDA rural development programs have been a primary source of funding. The Farm Security and Rural Investment Act of 2002 ("2002 Farm Bill") created the Renewable Systems and Energy Efficiency Improvements Program and amended the Value-Added Producer Grants program, both of which provided funding opportunities for digester projects.¹⁰⁷ The USDA also awarded \$41.9 million to renewable energy projects during the summer of 2008.¹⁰⁸ These projects, funded under the Renewable Energy Systems and Energy Efficiency Improvements Program, included ten AD projects, which received grants totaling \$4.4 million and loans of \$5 million.¹⁰⁹

The Food, Conservation, and Energy Act of 2008 ("2008 Farm Bill") continues federal support of renewable energy projects, including AD.¹¹⁰ The Rural Energy for America Program ("REAP") provides loans and grants for renewable energy and energy efficiency projects, including feasibility studies, and covering up to 25% of a project's cost through grants and authorizing loans for the remainder of the cost up to twenty-five

¹⁰⁴ See Impact of Renewable Energy Production in Rural America: Full Committee Hearing Before the H. Comm. on Small Business, 110th Cong. 14 (2007) (statement of Leon Graves, Nat'l Council of Farmer Coops.).

¹⁰⁵ *Id.*

¹⁰⁶ *See id.*

¹⁰⁷ Mattocks & Wilson, *supra* note 38, at 62.

¹⁰⁸ AgSTAR, *USDA Awards Farm Bill Grants and Loans*, AGSTAR DIGEST, Fall 2008, at 3, available at <http://www.epa.gov/agstar/news-events/digest/2008fall.html#three>.

¹⁰⁹ *Id.*

¹¹⁰ The Food, Conservation, and Energy Act of 2008 ("2008 Farm Bill"), Pub. Law 110-246, 122 Stat. 1651, § 9007.

million dollars.¹¹¹ Congress has extended funding through 2012 to support the program.¹¹² Some projects may also qualify for funding under the Rural Business Opportunities Grants program,¹¹³ Rural Business Enterprise Grants program,¹¹⁴ Environmental Quality Incentives Program,¹¹⁵ Value-Added Producer Grants program,¹¹⁶ and Business and Industry Guaranteed Loan Program.¹¹⁷ AD facilities that produce energy may also qualify for the Federal Renewable Electricity Production Tax Credit.¹¹⁸ The Sustainable Agriculture Research and Education Act generate funds for projects that will provide research and serve as demonstrations.¹¹⁹ Grants for projects that contribute to nonpoint source water pollution control may also be available through CWA § 319.¹²⁰

There have even been several attempts to pass bills specifically addressing biogas promotion. From 2007 to 2009, Biogas Production Incentives Acts were introduced in Congress.¹²¹ These bills have proposed several incentives for production of biogas: business tax credits; loans, loan guarantees, and grants to fund the cost of collecting and transporting materials to be digested; and countercyclical payments from Commodity Credit Corporation funds related to the price of natural gas.¹²² Although these bills have not passed, they do indicate that biogas production is on Congress's radar.

¹¹¹*Id.*; AgSTAR, *Incentive Detail: Rural Energy for America Program*, <http://www.epa.gov/agstar/tools/funding/incentive/USruralenergyforamericaprogramreap.html> (last updated Dec. 20, 2010).

¹¹²*Id.*

¹¹³ AgSTAR, *Incentive Detail: Rural Business Opportunity Grants*, <http://www.epa.gov/agstar/tools/funding/incentive/USruralbusinessenterpriseenterprise.html> (last updated Dec. 20, 2010).

¹¹⁴ AgSTAR, *Incentive Detail: Rural Business Enterprise Grants*, <http://www.epa.gov/agstar/tools/funding/incentive/USruralbusinessenterpriseenterprise.html> (last updated Dec. 20, 2010).

¹¹⁵ AgSTAR, *Incentive Detail: Environmental Quality Incentives Program*, <http://www.epa.gov/agstar/tools/funding/incentive/USenvironmentalqualityincentivesprogra.html> (last updated Dec. 20, 2010). "The 2008 farm bill lowers the EQIP payment limit to \$300,000 (down from \$450,000) in any 6-year period per entity, except in cases of special environmental significance including projects involving methane digesters, as determined by USDA." TADLOCK COWAN, RENEE JOHNSON & MEGAN STUBBS, CONG. RESEARCH SERV., CRS REPORT FOR CONGRESS: CONSERVATION PROVISIONS OF THE 2008 FARM BILL 7 (2008).

¹¹⁶ AgSTAR, *Incentive Detail: Value-Added Producer Grants*, <http://www.epa.gov/agstar/tools/funding/incentive/USvalueaddedproducergrants.html> (last updated Dec. 20, 2010).

¹¹⁷ AgSTAR, *Incentive Detail: Business and Industry Guaranteed Loan Program*, <http://www.epa.gov/agstar/tools/funding/incentive/USbusinessandindustryguaranteedloanpro.html> (last updated Dec. 20, 2010).

¹¹⁸ AgSTAR, *Incentive Detail: Federal Renewable Electricity Production Tax Credit*, <http://www.epa.gov/agstar/tools/funding/incentive/USfederalrenewableelectricityproductio.html> (last updated Dec. 20, 2010).

¹¹⁹ Sustainable Agriculture Research & Education (SARE), *SARE Funding Opportunities*, <http://www.sare.org/grants/> (last visited Feb 13, 2011).

¹²⁰ AgSTAR, *Incentive Detail: Nonpoint Source Water Pollution Control*, <http://www.epa.gov/agstar/tools/funding/incentive/USnonpointsourcewaterpollutioncontrol.html> (last visited Feb. 13, 2011); 33 U.S.C. § 1329 (h) (2008).

¹²¹ H.R. 2038, 110th Cong. (2007); S. 1154, 110th Cong. (2007); H.R. 7097, 110th Cong. (2008); H.R. 1158, 111th Cong. (2009); S. 306, 111th Cong. (2009).

¹²²*Id.*

At the state level, thirty-six states currently offer incentives to operate AD facilities, including grants, loans, loan guarantees, production incentives, tax incentives, and rebates.¹²³ In 2001, California's Senate Bill 5X became law, which provided \$9.64 million to be distributed by the California Energy Commission ("CEC") for the promotion of energy-producing AD facilities at dairies.¹²⁴ The CEC gave applicants the option of either a buy-down grant covering up to 50% of the system's capital cost or a production incentive guaranteeing a rate of 3.6 cents/kWh for a five-year period.¹²⁵

In 2007, Oregon passed House Bill 2210, which provides a tax credit to producers or collectors of biogas based on the amount of manure processed.¹²⁶ The Tillamook Bay digester will be one of facilities covered by the new legislation.¹²⁷ The digester is owned by the Port of Tillamook Bay ("POTB"), a public authority with no tax burden, and farmers generally do not have a tax burden large enough to equal the expected credits; therefore, the POTB and the current operators of the facility plan to market the tax credits and use the revenue to continue to fund the digester's operations and further AD development.¹²⁸

The effects of the current economic crisis are still unknown—tighter purse strings have the potential to cut into future funding for AD projects—but the 2008 Farm Bill's funding for biomass energy projects and the Obama administration's emphasis on the creation of "green" jobs and promotion of renewable energy are a good sign for the future of AD. While possibilities for funding may be reduced in the future, it seems likely that resources will still be available to continue the increased use of AD facilities.

2. Centralized Facilities and New Ownership Models

The cost of AD technology may also be managed through the use of regional facilities, rather than requiring each farm to build its own on-farm digester.¹²⁹ One of the primary problems noted in 1973 was the issue of economies of scale; the investment in AD technology only made economic sense for large facilities handling large amounts of manure.¹³⁰ However, the use of cooperative projects that allow multiple smaller farms

¹²³ AgSTAR, *AgSTAR Funding On-Farm Biogas Recovery Systems: A Guide to Federal and State Resources*, <http://www.epa.gov/agstar/tools/funding/index.html> (last visited Jan. 5, 2011).

¹²⁴ See PORTER ET AL., *supra* note 50, at 2.

¹²⁵ *Id.* at 3.

¹²⁶ Nora Goldstein, *Community Digester Aids Farms and Environment*, BIOCYLE, May 2008, at 50.

¹²⁷ *See id.*

¹²⁸ *Id.*

¹²⁹ See Riggle, *supra* note 1, at 75.

¹³⁰ See THORNTON, *supra* note 40, at 33-34.

to transport their manure to a single facility is one way that today's livestock producers are overcoming this obstacle.¹³¹ This approach, unfortunately, has several drawbacks that may limit its use. The cost to transport manure from a farm to the digester can limit its economic feasibility.¹³² Another challenge is that under some utility and environmental regulations, off-farm systems may not qualify for the same favorable treatment that on-farm systems receive.¹³³

Instead of requiring a farmer to own an AD system and bear all the related risks, projects could also be owned by utility companies, private parties, or cooperatives.¹³⁴ These alternative ownership models are another way of facilitating the development of agricultural AD projects. Microgy, Inc., is one example of a third party that builds digesters to treat livestock waste while retaining ownership of the AD system.¹³⁵ The corporation then sells the gas on the open market or back to the livestock producer for on-farm use.¹³⁶ If these projects are proven to be financially feasible, other companies will likely follow.

B. Regulatory Roadblocks

Although environmental concerns encourage the adoption of AD systems, they may also cause problems for producers when trying to obtain necessary permits for their AD projects. Producers who wanted to build AD systems in the 1970s faced fewer environmental regulations, and the regulations that developed over the past three decades generally have not addressed AD systems due to their rare use. The EPA does regulate reuse of municipal wastewater treatment biosolids under 40 C.F.R. pt. 503,¹³⁷ however, no similar federal standards exist for biosolids from AD facilities.¹³⁸ States are left to develop their own regulatory and permitting

¹³¹ See Riggle, *supra* note 1, at 75.

¹³² See Kimberly L. Bothi & Brian S. Aldrich, *Feasibility Study of a Central Anaerobic Digester for Ten Dairy Farms in Salem, NY* 4 (2005), available at http://www.manuremanagement.cornell.edu/Pages/General_Docs/Fact_Sheets/Salem_feasibility_factsheet_2005.pdf.

¹³³ *Id.* at 4, 6.

¹³⁴ Goodfellow Agricola Consultants, Inc., *The elorin Bioenergy Feasibility Study: Anaerobic Digestion for Bioelectricity Production, Executive Summary 7-8* (2007), available at <http://elorin.ca/documents/GoodfellowADReport-ExecutiveSummary.pdf>.

¹³⁵ Claudia H. Deutsch, *Tapping the Latent Power in What's Left Around the Barnyard*, N.Y. TIMES, July 4, 2006, at C1; Microgy, Inc., a Subsidiary of Environmental Power Corporation, *Executes Long-Term Gas Sale*, BUSINESS WIRE, July 19, 2005, <http://www.allbusiness.com/energy-utilities/renewable-energy-biomass/5004034-1.html>.

¹³⁶ *Id.*

¹³⁷ 40 C.F.R. § 503.1 (2011); See generally EPA, *BIOSOLIDS GENERATION, USE, AND DISPOSAL IN THE UNITED STATES* (1999), available at <http://www.epa.gov/osw/conserve/rrr/composting/pubs/biosolid.pdf>.

¹³⁸ Robert Spencer, *State Regulation of On-farm Anaerobic Digestion*, BIOCYCLE, Oct. 2007, at 58. AgSTAR has now developed standards for three common types of digesters; however, the purpose of these standards is to provide "some level of consumer protection" for producers who

schemes, and many are still in the process of working through the issues that AD systems present. Obtaining the required permits to build and operate an AD systems can require multiple permits related to water and air quality, zoning, solid waste disposal, and utility connections.¹³⁹ Delays often result from a variety of sources, including the use of prior regulatory frameworks that are not well suited to regulation of AD, a complete lack of regulation without any model to follow, or from a lack of the requisite knowledge needed to make informed policy decisions.¹⁴⁰ If some aspects are clearly regulated by specific agencies, but other aspects do not seem to fall within any agency's jurisdiction, both a lack of regulation and conflicting regulation can occur in the same state. Even within a state, different districts may be left to develop their own procedures, resulting in a lack of consistency.¹⁴¹ Regulators may also lack the requisite knowledge about AD treatment facilities, requiring the livestock producer to attempt to educate the decision-makers.¹⁴² As a result of all these challenges, obtaining the necessary permits can be the biggest problem for some facilities,¹⁴³ and the process can take several years to complete.¹⁴⁴

California provides one example of how complicated regulatory requirements can stunt development. California historically has been a strong supporter of AD, but adoption at California dairy farms has been slow.¹⁴⁵ One source of confusion, the complete absence of a definition of "anaerobic digestion," has led to uncertainty about agency jurisdiction for purposes of solid waste management.¹⁴⁶ California's separation of air and water quality oversight is another source of complications.¹⁴⁷ The State's rule requiring small dairies to comply with its distributed generation

purchase them, rather than providing environmental protection. Riggle, *supra* note 1, at 75 (quoting Kurt Roos, AgSTAR Program Dir.); see AGSTAR, *supra* note 10, at App. F.

¹³⁹ See generally Spencer, *supra* note 141.

¹⁴⁰ See SCOTT J. ANDERS, ENERGY POL'Y INITIATIVES CTR., BIOGAS PRODUCTION AND USE ON CALIFORNIA'S DAIRY FARMS: A SURVEY OF REGULATORY CHALLENGES at ii-iii (2007), http://www.sandiego.edu/epic/research_reports/documents/BiogasRegulatoryPaper_FINAL_001.pdf.

¹⁴¹ See Spencer, *supra* note 141, at 59 (noting that most dairies in California operate according to Waste Discharge Orders from regional water quality control boards, and that each region develops its own regulations).

¹⁴² See AgSTAR, *supra* note 11, at 8-1.

¹⁴³ Bob Krauter, *National Conference Explores Promise, Pitfalls of Methane Digesters*, CAPITAL PRESS AGRIC. NEWS, Nov. 28, 2007 (quoting Roy Sharp, panel member at AgSTAR Nat'l Conference), [available at http://capitalpress.com/main.asp?SectionID=94&SubSectionID=801&ArticleID=37242](http://capitalpress.com/main.asp?SectionID=94&SubSectionID=801&ArticleID=37242).

¹⁴⁴ One Oklahoma resident who received almost \$1.5 million in funds from Arkansas, Oklahoma, and private poultry companies had to deal with delays lasting several years and eventually had to move his proposed facility to a different site before construction could begin. See Robert J. Smith, *Engineer's Dream to Convert Litter Nears Testing Time*, ARK. DEM. GAZETTE, July 28, 2007.

¹⁴⁵ See Bob Krauter, *supra* note 146.

¹⁴⁶ See ANDERS, *supra* note 62, at ix. Because AD was not defined, the California Integrated Waste Management Board has asserted jurisdiction of waste management regulation under their rules governing composting. See *id.*

¹⁴⁷ Krauter, *supra* note 146.

certificate program is also a barrier, because the internal combustion engines used to generate electricity from the methane are not approved.¹⁴⁸ California producers are also uncertain as to potential uses for the effluent after digestion because of a lack of standards covering salt content.¹⁴⁹ The development of a permit program handled by a single agency has been recommended.¹⁵⁰

Another regulatory problem for some facilities is the restrictive regulation of co-digestion—the use of different inputs in addition to manure, such as wastes from rendering plants, food processors, restaurants, and crop residue. A variety of inputs can be used in addition to animal wastes: crop residues, municipal waste, residential yard waste and grass clippings, and food and beverage processing wastes.¹⁵¹ Compared to other wastes, manure emits a relatively low amount of methane during digestion, and the ability to use additional types of waste as substrates can increase methane production.¹⁵² A switch from 100% manure to a mix of 50% manure and 50% food waste can more than double the amount of methane produced.¹⁵³ Additional revenue comes from tipping fees that AD owners can charge for accepting the wastes.¹⁵⁴

Although co-digestion can increase the amount of green energy produced and help reduce waste problems for other industries, the use of materials besides manure is sometimes restricted by state regulations. For example, the Michigan Department of Environmental Quality advises that while producers using AD for manure treatment do not need any additional permits related to water quality, an additional permit or authorization may be needed if the producer starts accepting other wastes.¹⁵⁵ California addresses co-digestion proposals on a case-by-case basis, requiring the producer to present information on the estimated concentrations of salts and other pollutants and show that the addition of other types of waste will not threaten water quality.¹⁵⁶ Oregon's Tillamook Bay community digester

¹⁴⁸ ANDERS, *supra* note 145, at iii.

¹⁴⁹ *See id.*

¹⁵⁰ *See id.*, at vi.

¹⁵¹ Goodfellow Agricola Consultants, Inc., *supra* note 132, at 2-3.

¹⁵² Joe Kramer & Larry Krom, *Farm Digester Progress in Wisconsin*, BIOCYLE, Dec. 2008, at 38, 39.

¹⁵³ NORMAN SCOTT & JIANGUO MA, A GUIDELINE FOR CO-DIGESTION OF FOOD WASTES IN FARM-BASED ANAEROBIC DIGESTERS 2 (2004), available at http://www.manuremanagement.cornell.edu/Pages/General_Docs/Fact_Sheets/Codigestion_factsheet.pdf. Food wastes typically have a high energy content, but may also have characteristics that disrupt AD systems designed for manure. *Id.*

¹⁵⁴ Mich. Dep't of Agric., Opportunities, Constraints, and Research Needs for Co-digestion of Alternative Waste Streams with Livestock Manure in Minnesota 6 (2005), available at <http://www.mnproject.org/pdf/CombinedWasteStreamsReport.pdf>.

¹⁵⁵ Minn. Dep't of Envtl. Quality, Environmental Regulations Affecting Anaerobic Digesters 3 (2007).

¹⁵⁶ Spencer, *supra* note 141, at 60.

plans to begin a pilot project to accept food production wastes such as cheese whey, processed fruit and vegetables, and microbrewery wastes.¹⁵⁷

C. Development of Markets

To encourage its widespread adoption, AD technology must offer benefits to farmers and facility owners beyond its environmental benefits. The technology also must offer additional financial benefits and full development of such depending upon the establishment of markets in which to offer AD's byproducts—electricity or biogas, carbon offsets, and solid wastes that can be used as soil amendments or animal bedding.

1. Resale of Excess Electricity

While using the resulting energy produced through AD on-farm is relatively easy, the process of selling excess energy to a utility company can be difficult and a utility contract can have a substantial impact on a project's profitability.¹⁵⁸ The process of negotiating a utility contract varies widely depending on the organization and policies of the utility company, and it can range from a straightforward process based upon a utility's established standard process to a burdensome time-consuming endeavor involving multiple organizational groups within the utility company's structure.¹⁵⁹ Several types of agreements may be used for the sale of energy to utility companies, including buy all-sell all, surplus sale, and net metering.¹⁶⁰ The type of agreement can have a significant impact on a project's feasibility.¹⁶¹ In order to sell excess energy to a utility company, equipment upgrades may be necessary at the point of connection.¹⁶² The burden may fall on farmers to cover the related expenses, and that can be enough to prevent the sale of energy completely.¹⁶³

¹⁵⁷ Goldstein, *supra* note 129, at 50. The article notes that the Tillamook facility, because it is not located on a farm, has a solid waste permit which allows it to conduct the pilot project with the approval of the state. *Id.*

¹⁵⁸ AgSTAR, *supra* note 11, at 5-1.

¹⁵⁹ *Id.*

¹⁶⁰ Under a buy all-sell all agreement, the farmer buys all its electricity from the utility company, and the utility company purchases all electricity generated by the farmer's generator. AgSTAR, *supra* note 11, at 5-2. This arrangement is generally not advantageous to the farmer. *See id.* A surplus sale agreement provides that any energy in excess of that used by the farm is purchased by the utility company. *Id.* Net metering allows a farmer to offset his energy produced against his energy used on a set basis. *Id.* Another potential arrangement is "wheeling," which allows the direct sale of the generated electricity to another party using the utility's transmission lines. *Id.* at 5-6. Even if a farm is using its own energy, utility companies may charge a standby fee just for the farm's connection to the grid in case it needs power from the utility. *Id.*

¹⁶¹ AgSTAR, *supra* note 11, at 5-1

¹⁶² Lusk, *supra* note 18, at 46.

¹⁶³ One farmer faced interconnection costs of between \$50,000 and \$75,000; he chose to use the excess methane to fuel a boiler for extra heating instead of connecting to the utility. Diane Greer, *Financing an Anaerobic Digester*, BIOCYCLE, Dec. 2007, at 44. In the case of one dairy in New York,

Some utility companies choose to buy energy from producers at the full retail rate or even at a premium. East Central Energy in Minnesota buys excess energy from farmers and then sells the electricity to consumers at a premium through its green power program.¹⁶⁴ One program that serves as a model of cooperation among farmers, the utility company, and energy consumers is the Central Vermont Public Service (“CVPS”) Cow Power Program.¹⁶⁵ Customers may choose to buy 25%, 50%, or 100% of their power at a premium of four cents per kWh.¹⁶⁶ The customers’ payments are used to pay farmers 95% of the market price plus the four cent premium.¹⁶⁷ When customers collectively pay for more “cow power” than has been produced, CVPS purchases renewable energy certificates, if available, or deposits the money into the CVPS Renewable Development Fund.¹⁶⁸ CVPS makes no profit from the Cow Power program.¹⁶⁹

2. Carbon and Renewable Energy Credits

In the 1980s, placing a monetary value on the environmental benefits of AD was difficult, and as a result, that benefit was not included in economic assessments of AD’s benefit.¹⁷⁰ This omission reduced AD’s apparent value,¹⁷¹ but as systems for renewable energy and carbon credits are developed, a financial amount can now be assigned to the environmental benefit of biogas production. The EPA lists four “key accounting principles” necessary for greenhouse gas reduction offsets to be credible: offsets must be real, additional, permanent, and verifiable.¹⁷² The EPA has developed performance standards for both the avoidance of methane emissions through its capture,¹⁷³ and for the end use of the methane

the farmer’s cost to make necessary infrastructure upgrades was approximately \$100,000, yet the title to the upgraded equipment was to remain with the utility company. See Lusk, *supra* note 18, at 46.

¹⁶⁴ NELSON & LAMB, *supra* note 10, at 16.

¹⁶⁵ See Cent. Vt. Pub. Serv. (CVPS) Cow Power, <http://www.cvps.com/cowpower> (last visited Mar. 7, 2011); see also Molly Farrell Tucker, *Farm Digesters for Small Dairies in Vermont*, BIOCYCLE, Apr. 2008, at 44.

¹⁶⁶ CVPS Cow Power, Costs, <http://www.cvps.com/cowpower> (follow “Enroll” hyperlink; then follow “Costs” hyperlink) (last visited Feb. 14, 2011). As of March 2009, approximately 4,000 of its 159,000 customers participated in the program at some level. E-mail from Stephen Costello, CVPS Dir. of Pub. Affairs (Mar. 23, 2009) (on file with author).

¹⁶⁷ CVPS Cow Power, *Where’s my money go?*, <http://www.cvps.com/cowpower/Enrollpercent20Money.html> (last visited Mar. 14, 2009).

¹⁶⁸ *Id.*

¹⁶⁹ *Id.*

¹⁷⁰ HOBSON & WHEATLEY, *supra* note 4, at 227-28.

¹⁷¹ *Id.* at 228.

¹⁷² EPA, Climate Leaders Greenhouse Gas Inventory Protocol Offset Project Methodology for Project Type: Managing Manure with Biogas Recovery Systems 3 (2008), http://www.epa.gov/climateleaders/documents/resources/ClimateLeaders_DraftManureOffsetProtocol.pdf.

¹⁷³ See generally *id.*

as a renewable energy source.¹⁷⁴ Furthermore, a transparent and fair protocol for determining the biogas yield, converting it into a carbon credit, and determining the value of the credit must be developed in order for farmers to become active participants; this is due to farmers' lack of confidence in their compensation.¹⁷⁵

3. *Post-Digest Waste Materials*

In 1993, one summary of the state of AD technology noted that "the positive uses for digester effluents are rather limited."¹⁷⁶ In contrast to that disheartening conclusion, the range of uses currently proposed for digest effluent reveals the level of innovation of today's livestock producers and AD developers. Solids are now being reused as bedding for animals, fertilizer, and aquaculture supplements.¹⁷⁷ One farmer has begun to convert effluent to low-nutrient liquid and pelletized solids.¹⁷⁸ The liquid is low enough in nutrients to be land-applied in compliance with state regulations, and this saves the swine facility the cost of hauling the untreated effluent away.¹⁷⁹ The pellets have potential for a variety of uses, including as fertilizer and a fuel source.¹⁸⁰

In addition to creating a demand for renewable energy, the current problems with dependence on fossil fuels can also provide encouragement for the use of AD substrates as a fertilizer. AD results in a nutrient-rich effluent that is almost odorless.¹⁸¹ If a solid-liquid separation system is also installed, byproducts like high nutrient pellets can be generated.¹⁸² After the liquid is removed, these products are easier to transport.¹⁸³ This benefit is especially important to CAFOs located in areas where the amount of cropland for application of the nutrients is limited. The ability to move the nutrients out of the area to cropland where the nutrients are needed can solve the livestock producers' waste disposal problem and the crop growers' challenge of obtaining adequate fertilizer at a fair price.

¹⁷⁴ See generally EPA, Climate Leaders Greenhouse Gas Inventory Protocol Offset Project Methodology for Project Type: Captured Methane End Use (2008), <http://www.epa.gov/climateleaders/documents/resources/EndUseOffsetProtocol.pdf>.

¹⁷⁵ See Lusk, *supra* note 18, at 45, 48. A detailed discussion of the development of these markets is beyond the scope of this article; for additional information, see generally K. Charles Ling & Carolyn Liebrand, *Carbon Credits for Farmers*, RURAL COOPERATIVES, Nov.-Dec. 2008, at 10-12.

¹⁷⁶ HOBSON & WHEATLEY, *supra* note 4, at 228.

¹⁷⁷ AGSTAR, *supra* note 11, at 1-1.

¹⁷⁸ See Greer, *supra* note 166, at 44.

¹⁷⁹ *Id.* at 45-46.

¹⁸⁰ *Id.* at 44-45.

¹⁸¹ AGSTAR, *supra* note 11, at 1-5.

¹⁸² Greer, *supra* note 166, at 44-45.

¹⁸³ *Id.*

D. Public Perception

A final hurdle that AD will have to overcome is the negative image in the eyes of some of its critics. While AD has numerous proponents in the United States, some have questioned its legitimacy as an answer to our nation's farm waste and energy problems. The agriculture industry's recent negative experience with ethanol production, made possible through extensive government support, has shown that agriculture's involvement in energy policy is not always well-planned or successful.¹⁸⁴ Critics of AD provide several reasons to be cautious in our enthusiasm for the future of AD on the farm, citing potential limitations of the technology, as well as larger policy issues. While many of the critics are organizations known for their opposition to intensive livestock farming, the EPA has also acknowledged some limitations of AD use:

[A]naerobic digesters offer certain benefits to CAFOs (*e.g.*, energy recovery, control of methane emissions), but they would not necessarily lead to significant reductions for many of the pollutants discharged to surface waters from CAFOs. Mandating the use of anaerobic digesters could divert resources from or complicate the installation of other technologies that can achieve even better performance. Further, use of an anaerobic digester does not eliminate the need for liquid impoundments Digesters do not necessarily reduce the nutrients in animal wastes. Most of the phosphorus removed from the effluent is concentrated in the digested solids, which are still subject to land application requirements. Similarly, metals present in the animal waste are not reduced and remain in the digester effluent and solids.¹⁸⁵

Additional concerns cited by critics are the following: the dangerous and highly explosive nature of methane; the production of small amounts of harmful gases including highly corrosive and potentially lethal hydrogen sulfide¹⁸⁶; the interference of antibiotics (often fed to animals at

¹⁸⁴ See generally Food & Agric. Org. of the United Nations (FAO), *The State of Food and Agriculture 2008, Biofuels: Prospects, Risks, and Opportunities* (2008), available at <ftp://ftp.fao.org/docrep/fao/011/i0100e/i0100e.pdf>.

¹⁸⁵ National Pollutant Discharge Elimination System Permit Regulation and Effluent Limitation Guidelines and Standards for Concentrated Animal Feeding Operations (CAFOs); 68 Fed. Reg. 7176, 7217 (Env'tl. Prot. Agency Feb. 12, 2003) (final rule) (codified and amended at 40 C.F.R. pts. 9, 122, 123, and 412).

¹⁸⁶ Eric M. Hallman & Brian S. Aldrich, *Hydrogen Sulfide in Manure Handling Systems: Health and Safety Issues*, CORNELL UNIVERSITY MANURE MANAGEMENT PROGRAM FACT SHEET S-2, 1 (2007 Update), available at <http://counties.cce.cornell.edu/oneida/H2S%20Safety%20factsheet%20FINAL%202-17-07.pdf>.

sub-therapeutic levels to promote faster growth) with the microbes required for AD to function properly; and problems related to temperature, wind, and precipitation.¹⁸⁷ It is also important to understand that AD does not reduce the amount of nutrients in the manure nor solve the problem of waste disposal.¹⁸⁸ These limitations reveal that AD is not a complete solution to all of animal production's problems with waste management and that, at best, it is only a partial remedy that must fit within a complete scheme of manure treatment.

Critics voice an even deeper concern as to AD's potential to encourage further intensification of livestock production.¹⁸⁹ The development of an AD facility "could encourage even greater regional concentration of animal operations by simplifying the manure disposal problem," which could cause more severe problems with odor and other disturbances for the unlucky neighbors of the livestock facilities.¹⁹⁰ The Sierra Club acknowledges that AD may be appropriate for use by some small operations and existing CAFOs, but argues that each situation must be considered on a case-by-case basis and that CAFOs should not receive public subsidies to fund their investments in AD.¹⁹¹ It also objects to new CAFOs, with or without AD technology, and believes that fuel which causes environmental damage is not a legitimate form of renewable energy: "The anaerobic decomposition of CAFO manure . . . is symptomatic of inefficient waste treatment, treatment necessitated by inefficient, wasteful industries, practices, and processes."¹⁹² Whether biogas should be considered a "renewable" form of energy seems to depend on one's opinion of the necessity of intensive livestock production; if intensive production is

¹⁸⁷ Sierra Club, *An Analysis of the Benefits of Farm-Scale Anaerobic Digesters in the United States* 6-8 (Sept. 2006), available at <http://www.sierraclub.org/factoryfarms/factsheets/manuredigesterpaper.pdf>.

¹⁸⁸ Reader's Q&A: Digested Versus Raw Manure, BIOCYCLE, Dec. 2003, at 14.

¹⁸⁹ See Animal Welfare Inst., *Biogas from Manure: How Green?*, AWI QUARTERLY, Summer 2004, at 7, available at <http://www.awionline.org/ht/display/ContentDetails/i/1835/pid/2508>.

¹⁹⁰ Marc Ribaud, *Managing Manure: New Clean Water Act Regulations Create Imperative for Livestock Producers*, AMBER WAVES, Feb. 2003, at 30, 36, available at <http://www.ers.usda.gov/Amberwaves/feb03/Features/ManagingManure.htm>. AD eliminates most odor from the digested waste; however, the storage of manure prior to treatment and during transportation may still be a problem. While some problems related to regional concentration could worsen, Ribaud states that "water quality problems would be mitigated as long as spills and storage failures were avoided." *Id.* Given the history of spills in some regions and the devastating environmental consequences, a livestock facility's neighbors may have little confidence in its ability to avoid accidents. See generally Michael A. Mallin, *Impacts of Industrial Livestock Production on Rivers and Estuaries*, 88 AM. SCIENTIST 26 (2000). For a comprehensive review of the negative health effects of living near an intensive livestock production facility, see generally Dana Cole et al., *Concentrated Swine Feeding Operations and Public Health: A Review of Occupational and Community Health Effects*, 108 ENVTL. HEALTH PERSPECTIVES 685 (2008).

¹⁹¹ Sierra Club Guidance: Methane Digesters and Concentrated Animal Feeding Operation (CAFO) Waste (2004), available at http://www.sierraclub.org/policy/conservation/methane_digesters.pdf.

¹⁹² *Id.*

here to stay, continuous production of large amounts of manure is unavoidable. The conversion of that manure into various byproducts is also unavoidable, and the use of AD to capture the resulting methane may be the best outcome.

VI. CONCLUSION

It will be interesting to see whether the current surge in interest can be maintained, or whether it will dissipate like it did previously in the 1970s. The problems that AD technology can solve are certainly not going away, and are likely to grow even more serious as livestock production continues to expand. Unlike intermittent fluctuations in the price of energy, which are often elevated to crisis levels by the news media and then instantly forgotten as soon as prices inevitably drop again, the problem of global warming is not going anywhere. Furthermore, there is an increasing pressure on the United States to develop a responsible energy plan that embraces renewable energy and modern technology. While AD systems offer many benefits, implementation of these systems can be complicated and expensive; therefore, careful consideration is required to ensure that AD projects are a good use of taxpayer resources and a good fit for both the livestock facility and surrounding community.

