

## **Making a Silk Purse of a Sow's Ear: Swine Waste to Energy Operations**

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North Carolina is one of the top pork producing states in the nation. Every year, millions of hogs are born, raised, and slaughtered in the state.<sup>1</sup> While this is undoubtedly a boon to the state's economy, it does have one unpleasant side effect: swine waste. All those hogs produce tons and tons of swine waste; so much swine waste that the management of it is an industrial activity unto itself.<sup>2</sup> Critics of the pork industry often argue that swine waste is both a major pollutant and a serious threat to human health.<sup>3</sup> Such claims have led the state government to impose regulations and restrictions on hog farms, and have led hog farmers to search for alternative methods of waste management. One bright spot is the emerging field of turning swine waste into electricity. This activity, incentivized by the North Carolina government, has both major potential and major questions. This article will lay out the state of swine waste to energy operation in North Carolina, examine the incentive structure, and suggest changes to that same structure.

### **Hog Heaven: Swine Farming in North Carolina**

Second only to Iowa, North Carolina leads the nation in hog farming.<sup>4</sup> In the state there are around ten million hogs, residing on just over 2,000 industrial farms.<sup>5</sup> These farms are concentrated in the southeastern corner of the state; Robeson, Wayne, Duplin, Sampson, and

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<sup>1</sup> USDA, 2007 CENSUS OF AGRICULTURE: HOG AND PIG FARMING (2007), [https://www.agcensus.usda.gov/Publications/2007/Online\\_Highlights/Fact\\_Sheets/Production/hogsandpigs.pdf](https://www.agcensus.usda.gov/Publications/2007/Online_Highlights/Fact_Sheets/Production/hogsandpigs.pdf).

<sup>2</sup> *Pure Farms, Pure Waters: North Carolina*, WATERKEEPER ALLIANCE, <http://waterkeeper.org/campaign/pure-farms-pure-waters/the-north-carolina-cafo-campaign/> (last visited Dec. 29, 2016).

<sup>3</sup> *Id.*

<sup>4</sup> USDA, *supra* note 1.

<sup>5</sup> *Pure Farms, Pure Waters: North Carolina*, *supra* note 2.

Bladen counties have particularly high concentrations of large hog farms, or concentrated animal feeding operations (CAFOs).<sup>6</sup> Duplin County alone had nearly \$1 billion in hog sales in 2007.<sup>7</sup> This was not always the case in North Carolina; hog farming only came to dominate the southeastern quarter of the state in the 1980s and 1990s, when state laws related to zoning, taxation, and agricultural subsidies changed to favor large swine farms.<sup>8</sup> Since then, many large corporations, including Smithfield Foods, Inc. and Tyson Foods, Inc. have invested heavily in eastern North Carolina hog farms.<sup>9</sup>

The legal and economic changes in swine farming led to the incredible concentration of hogs seen in North Carolina's CAFOs.<sup>10</sup> These farms, defined by the EPA based on their size and concentration, produce mind boggling amounts of waste.<sup>11</sup> The proper management of this waste is a matter of the utmost environmental importance. It is incredibly nutrient rich, containing high concentrations of nitrogen and phosphorus.<sup>12</sup> These nutrients, when introduced into bodies of water, can produce devastating algae blooms.<sup>13</sup> These blooms can suck all the oxygen out of a lake or river, killing fish and crowding out other forms of aquatic life.<sup>14</sup> In addition to the ecological consequences, the release of nitrate compounds into groundwater

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<sup>6</sup> *Fields of Filth: Locations of CAFOs in North Carolina*, THE ENVIRONMENTAL WORKING GROUP, [http://www.ewg.org/interactive-maps/2016\\_north\\_carolina\\_animal\\_feeding\\_operations.php](http://www.ewg.org/interactive-maps/2016_north_carolina_animal_feeding_operations.php) (last visited Dec. 29, 2016).

<sup>7</sup> USDA, *supra* note 1.

<sup>8</sup> Pat Stith, *Murphy's Law: For Murphy, Good Government Means Good Business*, THE NEWS & OBSERVER (Feb. 22, 1995).

<sup>9</sup> DUKE CTR. ON GLOBALIZATION, GOVERNANCE & COMPETITIVENESS, NORTH CAROLINA IN THE GLOBAL ECONOMY (2015).

<sup>10</sup> *Id.*

<sup>11</sup> EPA, REGULATORY DEFINITIONS OF LARGES CAFO, MEDIUM CAFO, AND SMALL CAFO (2015), [http://www3.epa.gov/npdes/pubs/sector\\_table.pdf](http://www3.epa.gov/npdes/pubs/sector_table.pdf).

<sup>12</sup> *Pure Farms, Pure Waters: North Carolina*, *supra* note 2.

<sup>13</sup> *Id.*

<sup>14</sup> TONY DUTZIK ET AL., CORPORATE AGRIBUSINESS AND AMERICA'S WATERWAYS: THE ROLE OF AMERICA'S BIGGEST AGRIBUSINESS COMPANIES IN THE POLLUTION OF OUR RIVERS, LAKES AND COASTAL WATERS 6 (Nov. 2010).

creates public health risks.<sup>15</sup> These compounds, which at ten milligrams per liter create a human health risk, can lead to cancer, thyroid malfunction, and blue baby syndrome, in which nitrates in drinking water damage hemoglobin in young children and cause them to slowly asphyxiate.<sup>16</sup> Beyond the serious environmental and health concerns, hog farms are simply unpleasant to be around. Those unfortunate enough to live downwind of a hog farm, a disproportionate number of whom are black, can suffer from burning eyes, respiratory problems, anxiety, and high blood pressure caused by the methane and, hydrogen sulfide, and ammonia that emanate from the hog waste lagoons.<sup>17</sup>

Waste lagoons are the source of many of hog farming's environmental problems. They are the most common method of managing the waste from CAFOs.<sup>18</sup> Waste is pumped into the lagoon, or pit, and allowed to sit untreated and uncovered.<sup>19</sup> In order to keep the lagoons from spilling their heavy metal and pathogen-laden slurry across the landscape, waste is occasionally pumped from the Pepto-Bismal colored ponds and sprayed onto nearby fields.<sup>20</sup> Both this controlled release of waste and the spills which sometimes occur when the lagoons overrun their banks can expose humans and wildlife to the harmful substances in swine waste.<sup>21</sup> The waste in lagoons also tends to leach into the groundwater, from which it can poison man and beast alike.<sup>22</sup>

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<sup>15</sup> EPA, BASIC INFORMATION ABOUT NITRATES IN DRINKING WATER (Feb. 5, 2014), <http://water.epa.gov/drink/contaminants/basicinformation/nitrate.cfm>.

<sup>16</sup> *Id.*

<sup>17</sup> Bruce Henderson, *NC Hog Farm Neighbors Seek Court Help to Stop the Stink*, THE NEWS & OBSERVER (Jan. 1, 2015).

<sup>18</sup> Wendee Nicole, *CAFOs and Environmental Justice: The Case of North Carolina*, 121(6) *Env'tl. Health Perspectives* A182, A186 (2013), <http://ehp.niehs.nih.gov/121-a182/>.

<sup>19</sup> *Id.*

<sup>20</sup> *Id.*

<sup>21</sup> J. Warrick & P. Stith, *New Studies Show that Lagoons are Leaking: Groundwater, Rivers Affected by Waste*, THE NEWS & OBSERVER (Feb 19, 1995).

<sup>22</sup> EPA, ANIMAL WASTE DISPOSAL ISSUES (1997).

The danger presented by lagoons was made apparent when Hurricane Floyd swept North Carolina in 1999 and flooded many eastern North Carolina lagoons.<sup>23</sup> Manure flowed out of the lagoons and into rivers, lakes, and wells across the region.<sup>24</sup> The more recent Hurricane Matthew demonstrated yet again the inherent danger of using lagoons to treat waste.<sup>25</sup>

In response to the dangers of the lagoon system, the North Carolina General Assembly has passed many laws regulating the hog CAFOS. One of the most important was the Swine Farm Performance Standards Bill.<sup>26</sup> With it, the General Assembly banned the construction of new hog lagoons unless they met specific technology standards.<sup>27</sup> Although currently existing lagoons were allowed to continue operating and to be maintained, all new construction was required to incorporate Environmentally Superior Technologies (EST).<sup>28</sup> The law also incentivized “the closure of sprayfield and lagoon systems that are [to be] replaced by innovative animal waste management systems.”<sup>29</sup> Unfortunately, few farms have adopted EST due to the high costs.<sup>30</sup>

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<sup>23</sup> Sarah Zhang, *North Carolina’s Floods Threaten to Unleash Lagoons of Pig Poop*, THE ATLANTIC (Oct. 12, 2016), <http://www.theatlantic.com/health/archive/2016/10/north-carolina-floods-threaten-to-unleash-lagoons-of-pig-poop/503828/>

<sup>24</sup> Peter T. Kilborn, *Hurricane Reveals Flaws in Farm Law as Animal Waste Threatens N. Carolina Water*, N.Y. TIMES (Oct. 17, 1999), <http://www.nytimes.com/1999/10/17/us/hurricane-reveals-flaws-in-farm-law-as-animalwaste-threatens-n-carolina-water.html?pagewanted=all>.

<sup>25</sup> Arelis R. Hernandez, *Factory Farming Practices are Under Scrutiny Again in N.C.*, THE WASHINGTON POST, (Oct. 16, 2016), <https://www.washingtonpost.com/news/capital-weather-gang/wp/2016/10/16/factory-farming-practices-are-under-scrutiny-again-in-n-c-after-disastrous-hurricane-floods/>.

<sup>26</sup> N.C. Gen. Sess. L. 2007-52.

<sup>27</sup> *Id.*

<sup>28</sup> *Id.*

<sup>29</sup> *Id.*

<sup>30</sup> ANNUAL REPORT TO THE ENVIRONMENTAL REVIEW COMMISSION OF THE NORTH CAROLINA GENERAL ASSEMBLY OF THE IMPLEMENTATION OF THE LAGOON CONVERSION PROGRAM (2014).

## Anaerobic Digesters

One of the most promising technologies that meets the EST standard is anaerobic digestion.<sup>31</sup> The technology works in a manner not unlike the electricity generation system in *Mad Max Beyond the Thunderdome*, in that it captures methane from pig waste and burns it to generate electricity.<sup>32</sup> By utilizing anaerobic digesters, hog farmers can dispose of waste more safely and generate electricity at the same time.<sup>33</sup> Anaerobic digestion works by scraping, rather than washing, the waste from the hog houses into a containment system.<sup>34</sup> This system uses space more efficiently, as scraped waste, at five to ten percent solids, requires much less space for treatment than the one to two percent solid waste that is pumped into most lagoons.<sup>35</sup> The scraped waste is then loaded onto trucks and emptied into a large, in-ground tank.<sup>36</sup> This tank, kept at around ninety-five degrees Fahrenheit in order to maintain the mesophilic bacteria within, is the site of the anaerobic digestion process.<sup>37</sup> The bacteria kill the dangerous pathogens in the pig waste and produce a 65 percent methane biogas which can be run in modified generators.<sup>38</sup> Such generators can provide abundant and reliable energy, enough to run at ninety-five percent capacity for months on end and to power both the farms on which they are located and the nearby houses.<sup>39</sup> They also produce wastewater that is pathogen free and has ninety percent less phosphorus and seventy-five percent less ammonia nitrogen than the manure fed into the

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<sup>31</sup> *An Innovative Approach to Energy Creation*, WITHERS & RAVENEL, withersravenel.com/case-studies/storms-farm (last visited December 29, 2016).

<sup>32</sup> MAD MAX BEYOND THE THUNDERDOME. (Kennedy Miller Productions 1985).

<sup>33</sup> Allison N. Hatchett, *Bovines and Global Warming: How the Cows are Heating Things Up and What can be Done to Cool Them Down*, 29 WM. & MARY ENVTL. L. & POL'Y REV. 767, 801 (2005).

<sup>34</sup> Melissa D. Brumback, *Turning Manure into Megawatts*, CONSTR. L. IN N.C. (Dec. 17, 2014), <http://constructionlawnc.com/2014/12/17/manure-into-megawatts/>.

<sup>35</sup> *Id.*

<sup>36</sup> *Id.*

<sup>37</sup> *Id.*

<sup>38</sup> *Id.*

<sup>39</sup> Lisa Ruffman-Weiss, *Ribbon cutting at North Carolina's largest fully operational swine waste-to-energy facility*, THE GREEN ECONOMY (July 3, 2014), [www.thegreeneconomy.com/content/pig-power](http://www.thegreeneconomy.com/content/pig-power).

digester.<sup>40</sup> The final product of anaerobic digestion is the solid waste, which is also pathogen free and nearly odorless, and may be used as soil conditioner, fertilizer, peat moss, or animal bedding.<sup>41</sup> The entire process also reduces the amount of malodorous chemicals (VOCs, NH<sub>3</sub>, H<sub>2</sub>S) and greenhouse gases (CH<sub>4</sub>) released into the atmosphere when compared with traditional lagoon systems.<sup>42</sup>

Anaerobic digesters are not, however, a perfect solution to the problems of swine waste. The disposal of solid waste is still a major issue.<sup>43</sup> Unlike the cleaner wastewater, solid waste products of anaerobic digesters are still loaded with phosphorus and nitrogen compounds.<sup>44</sup> These compounds can enter the water supply after the processed manure has been used as fertilizer, just as if the waste had been stored in a lagoon.<sup>45</sup> Many in the environmental protection community cite this solid waste as a serious concern.<sup>46</sup> Generally, environmentalists argue that unless it is treated in such a way that the phosphorus and nitrogen levels are reduced, anaerobic digesters are no better than lagoons.<sup>47</sup> The chemicals from the waste still end up on the fields and are from there washed into the rivers and groundwater of North Carolina.<sup>48</sup> While there are certain techniques that can reduce the chemical loads of the treated swine waste, such as the application of aluminum sulfate (alum) to bind and remove phosphorus, such methods are still in development.<sup>49</sup>

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<sup>40</sup> Brumback, *supra* note 34.

<sup>41</sup> *An Innovative Approach to Energy Creation*, *supra* note 31.

<sup>42</sup> WITHERS & RAVENEL, SWINE FARM ANAEROBIC DIGESTER BIO-GAS RENEWABLE ENERGY PROJECT (last visited Dec. 30, 2016), [www.ncsafewater.org/resource/collection/4251BFF9-9A46-46DD-A1C4-8A83FC72727F/ST\\_Mon\\_AM\\_0950\\_Wicker.pdf](http://www.ncsafewater.org/resource/collection/4251BFF9-9A46-46DD-A1C4-8A83FC72727F/ST_Mon_AM_0950_Wicker.pdf).

<sup>43</sup> Nicholas M. White, *Industry-Based Solutions to Industry-Specific Pollution: Finding Sustainable Solutions to Pollution from Livestock Waste*, 15 COLO. J. INT'L ENVTL. L. & POL'Y, 153, 156 (2004).

<sup>44</sup> *Id.*

<sup>45</sup> *Id.*

<sup>46</sup> Telephone Interview with Blakely Hildebrand, Assoc. Attorney, Southern Env'tl. L. Ctr. (Oct. 14, 2016).

<sup>47</sup> *Id.*

<sup>48</sup> *Id.*

<sup>49</sup> White, *supra* note 43.

Lloyd Ray Farms in Yadkinville, North Carolina has successfully implemented a swine waste to energy system in conjunction with a denitrification process.<sup>50</sup> The farm, made possible by a partnership of Duke Energy Corp., Duke University, and Google, Inc., uses technology that meets the EST standard to produce electricity and experiment with carbon offsetting techniques.<sup>51</sup> The partners are trying to use the farm to “generate electricity from swine waste, reduce greenhouse gas emissions from the farm, reduce ammonia and other odorous emissions from the farm, improve the quality of treated wastewater from the farm,” and make a profit doing so.<sup>52</sup> Their efforts have been fairly successful, as the electricity production has met the needs of the farm and the carbon reduction has succeeded in reducing emissions by forty percent of the estimated reductions possible.<sup>53</sup> Even the denitrification system has been fairly successful; it uses nitrifying bacteria to transform ammonia into nitrate and nitrite, which are then transformed by denitrifying bacteria into nitrogen gas.<sup>54</sup> There are, however, reasons to be hesitant in embracing the results of the Lloyd Ray Farms experiment. It has only been made possible by generous government subsidies.<sup>55</sup> Without these subsidies, no hog farmer would be willing or able to spend the three to five million dollars necessary to install such systems.<sup>56</sup> They also lack a plan to deal with phosphorus and the other pollutants present in the treated swine waste.<sup>57</sup> Furthermore, the process of capturing and burning the methane creates its own hazardous emissions, including nitrogen oxide, sulfur oxide, carbon monoxide, and ground-level ozone.<sup>58</sup>

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<sup>50</sup> *Lloyd Ray Farms*, DUKE SUSTAINABILITY, [http://sustainability.duke.edu/carbon\\_offsets/loyd-ray-farms/index.php](http://sustainability.duke.edu/carbon_offsets/loyd-ray-farms/index.php) (last visited December 30, 2016).

<sup>51</sup> *Id.*

<sup>52</sup> William G. “Gus” Simmons Jr., *Next Generation Technology Swine Waste to Energy Project*, NC SAFE WATER (Oct. 9, 2015), <http://articles.extension.org/pages/67693/next-generation-technology-swine-waste-to-energy-project>.

<sup>53</sup> *Lloyd Ray Farms*, *supra* note 47.

<sup>54</sup> *Id.*

<sup>55</sup> Nicole G. Di Camillo, *Methane Digesters and Biogas Recovery—Masking the Environmental Consequences of Industrial Concentrated Livestock Production*, 29 UCLA J. ENVTL. L. & POL’Y 365, 367 (2011).

<sup>56</sup> Camillo, *supra* note 55, at 376; WITHERS & RAVENEL, *supra* note 42.

<sup>57</sup> Camillo, *supra* note 55 at 367.

<sup>58</sup> *Id.*

It is, nevertheless, among the best examples of aerobic digestion and solid waste denitrification in North Carolina.

### **Incentives to Innovate**

The state incentivizes both farmers and energy providers to invest in anaerobic digesters.<sup>59</sup> Incentives for farmers come largely from Senate Bill 1456, which effectively codified the Smithfield Agreement, an earlier, informal pact between political and industry leaders.<sup>60</sup> It provides generous grants of up to ninety percent of implementation costs for farmers trying to implement environmentally superior technology on their farms and guarantees them a market for any electricity they might produce.<sup>61</sup> North Carolina also offers the Renewable Energy Corporate Tax Credit, which can cover up to thirty-five percent of the cost of any installation, up to \$2.5 million.<sup>62</sup> The credit is capped, however, at 50 percent of the farm's state tax liability.<sup>63</sup> This credit expired at the end of 2016 and is no longer available to new developers.<sup>64</sup>

Utility companies have a different set of incentives, based on Senate Bill 3.<sup>65</sup> This law requires all investor owned utilities to meet renewable energy portfolio standards which increase every year.<sup>66</sup> While many states have similar laws, North Carolina is unique in that it requires that a certain percentage of the energy be derived from swine waste.<sup>67</sup> Senate Bill 3 requires that

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<sup>59</sup> Telephone Interview with Megan Jennings, Renewable Compliance Manager, Duke Energy Corp. and Travis Payne, Bus. Dev. Manager, Duke Energy Corp. (Nov. 1, 2016).

<sup>60</sup> 2007 N.C. Sess. L. 523; Jennings, Payne, *supra* note 56

<sup>61</sup> 2007 N.C. Sess. L. 523

<sup>62</sup> DSIRE, Renewable Energy Tax Credit, DSIRE (last visited December 30, 2016), <http://programs.dsireusa.org/system/program/detail/540>

<sup>63</sup> *Id.*

<sup>64</sup> *Id.*; Jennings, Payne, *supra* note 59.

<sup>65</sup> Jennings, Payne, *supra* note 59.

<sup>66</sup> N.C. Gen. Stat. § 62-133.8 (2016).

<sup>67</sup> Jennings, Payne, *supra* note 59.

all investor owned utilities generate 0.07 percent of their energy from swine waste from 2015 to 2017, 0.14 percent from 2018 to 2020, and 0.2 percent in 2021.<sup>68</sup> Utilities can reach these goals by either generating the power themselves or purchasing renewable energy credits from third party sources.<sup>69</sup> The market for the sale of these credits is yet another incentive to produce renewable energy, as companies can profit from them if they are producing excess renewable energy.<sup>70</sup> The bill also includes a mechanism by which utilities may charge customers more to cover the added cost of producing renewable energy.<sup>71</sup> The North Carolina Utilities Commission may penalize utilities that fail to meet their goals, although they rarely do so if the utility has shown that it has made a good faith effort to comply.<sup>72</sup>

### **Improving the Incentive Structure**

The incentive structure put in place by the state to increase the amount of swine waste energy produced is, as one might glean from the preceding section, imperfect. All major parties—hog farmers, utility companies, and environmentalists—have concerns about the system as it stands and suggestions for improvement.

Hog farmers’ concerns are fairly easy to understand. They complain that none of the environmentally superior technologies required by the Smithfield Agreement are economically feasible.<sup>73</sup> The same complaint applies to anaerobic digesters that meet the EST standard created by the Swine Farm Performance Standards Bill.<sup>74</sup> Even with grants and tax credits from the

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<sup>68</sup> Renewable Energy and Energy Efficiency Portfolio Standard, DSIRE, <http://programs.dsireusa.org/system/program/detail/2660> (last updated Sep. 23, 2016).

<sup>69</sup> *Id.*

<sup>70</sup> Jennings, Payne, *supra* note 59.

<sup>71</sup> *Id.*

<sup>72</sup> DSIRE, *supra* note 68; Jennings, Payne, *supra* note 59.

<sup>73</sup> ANNUAL REPORT TO THE ENVIRONMENTAL REVIEW COMMISSION OF THE NORTH CAROLINA GENERAL ASSEMBLY OF THE IMPLEMENTATION OF THE LAGOON CONVERSION PROGRAM (2014).

<sup>74</sup> Jennings, Payne, *supra* note 59.

state, farmers fear that the upfront costs required to construct an anaerobic digestion system — sometimes in excess of \$4.5 million — are far too heavy a burden to bear.<sup>75</sup> Swine farmers also have high operation costs after the digester and generator are built.<sup>76</sup> Chief among these costs is that of transportation.<sup>77</sup> Because the digesters only take five to ten percent solid waste instead of the one to two percent solid waste taken by traditional lagoons, the waste has to be trucked from the houses to the digester.<sup>78</sup> This is a significant expense, for which some hog farmers would like to see some sort of compensation or subsidy.<sup>79</sup> Some farmers also complain that state environmental regulations, tailored to traditional lagoon farms, make it difficult to operate anaerobic digesters.<sup>80</sup> They claim that many aspects of the work, particularly the trucking of waste from hog house to digester, is made nearly impossible.<sup>81</sup> They would also like to see the state tax credits for anaerobic digesters extended and expanded to include other biogas projects, such as efforts to generate fuel for farm vehicles.<sup>82</sup>

Utilities companies also have changes that they would like to see implemented in the incentive structure. Many in the utility industry are concerned about the inability of companies to meet their renewable energy portfolio standards for swine waste energy due to lack of supply.<sup>83</sup> While the penalties for failing to meet the standards are consistently waived by the Utilities Commission, industry professionals would like to make progress towards meeting the statutory requirements.<sup>84</sup> They express concern over the fact that, because the utility companies don't actually own the digesters, they cannot gain access to most of the grants and tax credits—these

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<sup>75</sup> WITHERS & RAVENEL, *supra* note 42; Jennings, Payne, *supra* note 59.

<sup>76</sup> Jennings, Payne, *supra* note 59.

<sup>77</sup> *Id.*

<sup>78</sup> Brumback, *supra* note 34.

<sup>79</sup> Jennings, Payne, *supra* note 59.

<sup>80</sup> Telephone Interview with Angie Maier, Lobbyist, NC Pork Council (Nov. 15, 2016).

<sup>81</sup> *Id.*

<sup>82</sup> *Id.*

<sup>83</sup> Jennings, Payne, *supra* note 59.

<sup>84</sup> *Id.*

carrots are available only to the hog farmers.<sup>85</sup> There is a “huge disconnect” between the supply of power and the demand for it, in large part because while all investor-owned utilities are required to buy swine waste energy, no hog farmers are required to produce it.<sup>86</sup> Many would prefer to see hog farmers offered more incentives (or requirements) to produce energy from their swine waste and to sell the resulting renewable energy credits to utility companies.<sup>87</sup>

Environmentalists also have concerns about anaerobic digesters. Many of them cite concerns about the solid waste byproduct of the digestion process.<sup>88</sup> This solid waste, though largely pathogen free, is still loaded with nitrogen and phosphorus.<sup>89</sup> Advocates of anaerobic digestion often promote it as an ideal fertilizer, but environmentalists are more skeptical.<sup>90</sup> They say that the excess nutrients in the treated swine waste can still leach into the groundwater or runoff into lakes or streams.<sup>91</sup> In this regard, they are considered by some environmentalists to be little better than traditional lagoons because the waste still ends up in the water supply and in aquatic ecosystems.<sup>92</sup> Many environmentalists would prefer that the state incentivize the addition of a separate nutrient reduction system to anaerobic digesters.<sup>93</sup>

## Conclusion

There are many ways to lessen the detrimental environmental impact of hog waste lagoons in North Carolina. Among the most promising of these is the use of anaerobic digesters to produce energy from the swine waste. Using anaerobic digestion, both hog farmers and utility

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<sup>85</sup> *Id.*

<sup>86</sup> *Id.*

<sup>87</sup> *Id.*

<sup>88</sup> Hildebrand, *supra* note 46.

<sup>89</sup> White, *supra* note 43.

<sup>90</sup> WITHERS & RAVENEL, *supra* note 42; Hildebrand, *supra* note 46.

<sup>91</sup> Hildebrand, *supra* note 46.

<sup>92</sup> *Id.*

<sup>93</sup> *Id.*

companies can profit, all while making a leading North Carolina industry more environmentally friendly. It is, however, still an imperfect solution. Even though it is incentivized by the state, anaerobic digestion is still prohibitively expensive. While all the actors involved have competing, or even mutually exclusive priorities, utility companies, farmers, and environmentalists can agree on one thing: they would like to see a far more robust incentive structure put into place. With stronger carrots, and perhaps stronger sticks, anaerobic digestion might finally be ready for its day in the sun,