

*Moving Waste Management to the Future: Implementing a
Facultative Bioreactor in Athens-Clarke County*

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Abstract

Methane (CH₄) is a greenhouse gas that is over 20 times more effective at trapping heat than carbon dioxide (CO₂) and can stay in the atmosphere up to fifteen years once released. The methane released in landfill gas comprises 23-34% of atmospheric methane, and is one of the largest human-related sources of methane emission. However, it makes up a large percentage of natural gas and is an excellent source of energy. By trapping the methane released from solid municipal waste landfills, it is possible to make positive use of it. Our research suggests the installation and implementation of a Landfill Gas to Energy program (LFGE), specifically a facultative bioreactor, on the Athens-Clarke County landfill. This would entail piping landfill gas out of the landfill. Once extracted, the methane will be processed and readied for use as an energy source. A partnership with the University of Georgia as the consumer of the gas will offset some of the cost of the facility. The landfill gas to energy program will reduce landfill gas emission and will allow Athens-Clarke County to use the methane gas as a source of energy and revenue for the county.

Introduction

As the global population booms, requiring more space and creating more waste than ever before, it is evident that the waste disposal methods used in the past are becoming outdated and even impossible in regions of extremely high-density populations. Everywhere people are

turning to alternative methods of waste disposal, using a variety of methods from incineration to recycling. *In Athens-Clarke County, the landfill is nearing full capacity. Within the next ten years it will be necessary to dispose of the county's waste elsewhere. Clearly, traditional dry-tomb landfilling, as ACC has done in the past, is no longer a reasonable option. After researching a variety of alternative methods, it became clear that the most viable and environmentally friendly option would be a facultative bioreactor. It also became apparent that the methane could be used as the perfect alternative to the coal-fired boiler that the University of Georgia currently uses.*

This paper begins by briefly outlining methane, the primary gas released when waste is broken down in a facultative bioreactor. It goes on to describe our proposal in detail, beginning with a description of the bioreactor itself and continuing by detailing the process required to implement the proposal. Finally, this paper discusses the impact of installing a facultative bioreactor in the county, addressing any stakeholders and weighing the benefits against the challenges that will arise.

Methane and Its Incarnations

Methane (CH₄), landfill gas (LFG), and natural gas are not interchangeable terms but three distinct entities. Methane gas (CH₄) is a naturally occurring hydrocarbon that is the byproduct of the decomposition of organic materials, but it is also, along with carbon dioxide, a powerful greenhouse gas (GHG) that is released into the atmosphere by natural and anthropogenic means.^{1,2} Landfill gas is between 40-60% methane. The other 60-40% is

¹ United States Environmental Protection Agency, "Methane," US EPA, <http://www.epa.gov/methane/> (accessed 11 December 2008).

² EnergyJustice.Net, "Landfill Gas Fact Sheet," Energy Justice Network, <http://www.energyjustice.net/lfg/factsheet-lfg.pdf> (accessed 11 December 2008).

predominantly carbon dioxide (CO₂), along with "non-methane organic compounds" (NMOC), such as nitrogen, oxygen, water vapors, sulfur, and inorganic contaminants like mercury.³ The composition of LFG will vary based on what is put into the landfill. Natural gas is 80-99% methane with traces of other hydrocarbons like butane (CH₃), propane (CH₂), and ethane (CH).⁴ The distinction between these three gases is important when discussing a landfill gas to energy system because they each have different components.

According to the Environmental Protection Agency (EPA), landfills are one of the largest sources of anthropogenic methane emission in the US. They account for a total of 34% of US methane emission into the earth's atmosphere, which in 2007 was recorded as 6,327 Gg.⁵ The problem of landfill gas emissions is made clear when compared to the next two anthropogenic sources, natural gas systems and coal mining emissions, which in 2007 were 4,985 and 2,744 Gg, respectively.⁶ It has also been observed that methane gas is 20 times more detrimental to the atmosphere than carbon dioxide, because it has an increased capability to trap heat in the atmosphere.⁷ Currently, the ACC landfill does not emit enough LFG for the US EPA to require that it be captured, but as ACC continues to grow, the community will subsequently create more waste, which will lead to greater emissions. Within the next decade, ACC LFG emissions will be too high to allow it to be released freely into the atmosphere, because emissions will surpass the EPA designated limit of 50 Mg/year.^{8,9}

3 Ibid.

4 Ibid.

5 United States Environmental Protection Agency, "Methane."

6 United States Environmental Protection Agency, "2009 Draft U.S. Greenhouse Gas Inventory Report," US EPA, <http://epa.gov/climatechange/emissions/usinventoryreport.html> (accessed 13 March 2009).

7 United States Environmental Protection Agency, "Methane."

8 United States Environmental Protection Agency, "Fact Sheet: Final Air Regulations for Municipal Solid Waste Landfills," US EPA, <http://epa.gov/ttn/atw/landfill/mswfact.pdf> (accessed 11 December 2008).

9 Corley, Jim. Interviewed by Malin Dartnell and Shanell Davis. Athens, Georgia, 17 February 2009.

The installation of a bioreactor in Athens-Clarke County's Municipal and Solid Waste Landfill can potentially decrease the county's carbon footprint by harnessing the LFG emitted to produce an alternative energy source and increase the lifespan of the current landfill through vertical expansion. The Solid Waste Association of North America (SWANA) defines a bioreactor as "any permitted Subtitle D landfill or landfill cell where liquid or air is injected in a controlled fashion into the waste mass in order to accelerate or enhance biostabilization of the waste".^{10, 11}

The use of a bioreactor to degrade organic waste is a departure from the traditional idea of a landfill. Traditionally, once a section of a landfill is full, it is capped to seal out as much moisture as possible. This process essentially creates a "dry tomb" for trash to slowly degrade over the span of 30 to 50 years.¹² In contrast, moisture is the key ingredient in a bioreactor. By creating an environment of optimal moisture (35-65% according to the EPA), naturally occurring microbes can rapidly decrease the decomposition and stabilization period of organic waste from decades to years and produce a higher volume of methane gas that can be captured.^{13, 14} Four types of bioreactor processes can be used: aerobic, anaerobic, hybrid, and facultative, each of which require slightly different conditions and yielding slightly different results (reference Table 1).¹⁵

10 Bioreactor.org, "Information," Hinkley Center for Solid and Hazardous Waste Management, <http://www.bioreactor.org/info.htm> (accessed 13 November 2008).

11 Solid Waste Association of North America, "Certification: Bioreactor Landfill," SWANA, <http://swana.org/Education/Educate/Certification/BioreactorLandfill/tabid/96/Default.aspx> (accessed 13 November 2008).

12 Bioreactor.org, "Florida Bioreactor Landfill Demonstration Project-Executive Summary," Hinkley Center for Solid and Hazardous Waste Management, <http://www.bioreactor.org/publications.htm> (accessed 13 November 2008).

13 Bioreactor.org, "Information."

14 United States Environmental Protection Agency, "Wastes-Non-Hazardous Municipal Solid Waste: Bioreactors," US EPA, <http://www.epa.gov/osw/nonhaz/municipal/landfill/bioreactors.htm> (accessed 13 December 2008).

15 WM-Waste Management, "Waste Treatment Landfill Brochure," Waste Management, <http://www.wm.com/wm/environmental/bioreactor.asp> (accessed 12 December 2008).

Table 1: Four Types of Bioreactor Systems

| Name | Process | End Product |
|---------------------------------------|---|---|
| Aerobic Bioreactor | <ul style="list-style-type: none"> • Vertical and/or horizontal wells remove leachate from the bottom layer and inject air into the landfill • Leachate is sent to a liquid storage tank before it is recirculated back into the landfill in a controlled manner • Naturally occurring microbes carry out aerobic respiration • Process consumes O₂ and produces CO₂, to rapidly decompose organic waste products | <ul style="list-style-type: none"> • Generates CO₂, not CH₄ • Could potentially eliminate the emission of CH₄ into the atmosphere • Cannot be used to generate an alternative energy source |
| Anaerobic Bioreactor | <ul style="list-style-type: none"> • Vertical and/or horizontal wells remove and recirculate leachate while capturing and collecting CH₄ gas • Occurs in the absence of O₂ | <ul style="list-style-type: none"> • Generates CH₄ at twice the rate of a normal landfill • Leads to more reliable higher peak volumes of CH₄ • Production of CH₄ decreases as organic waste decomposes fully • With consistent input the peak will flatten to a stable level of CH₄ production |
| Facultative Bioreactor | <ul style="list-style-type: none"> • Controls the production of the organic ammonia (NH₃) due to anaerobic respiration • Leachate is treated to convert NH₃ into nitrate (NO₃) and is recirculated back into the landfill where facultative bacteria and other microbes use NO₃, instead of O₂, for respiration and produce nitrogen gas (N₂) | <ul style="list-style-type: none"> • Yields CH₄, due to anaerobic respiration, and N₂, due to denitrification |
| Anaerobic-Aerobic (Hybrid) Bioreactor | <ul style="list-style-type: none"> • Combines both respiration processes to increase the rate of biodegradation in the aerobic stage and reduce the production of the organic acid ammonia (NH₃) in the anaerobic stage, leading to methanogenesis • The upper layer of the landfill is aerated and leachate is recirculated into the layer immediately below the aerated layer. LFG is then extracted from each layer below the liquid layer | <ul style="list-style-type: none"> • Creates N₂ and CH₄ through the combination of anaerobic and aerobic processes |

Source: WM-Waste Management, "Waste treatment Landfill Brochure," Waste Management, <http://www.wm.com/wm/environmental/bioreactor.asp> (accessed 12 December 2008).

Anaerobic, hybrid, and facultative bioreactors produce CH₄ at about twice the rate of traditional landfills.¹⁶ As stated before, the emissions can be collected and sold as an alternative energy source. The constant rate of CH₄ generation allows for recovery over the lifespan of the landfill so long as the input remains constant.¹⁷ In a traditional landfill, LFG emissions peak then decrease over time, making it less economical than capturing emissions from a bioreactor.¹⁸ Bioreactors require optimal moisture, therefore the leachate produced, augmented by storm water, wastewaters, or wastewater treatment plant sludge, is needed for respiration to occur.¹⁹ By using these types of liquids, MSW treatment plants will significantly reduce, if not eliminate, leachate disposal and treatment fees.^{20, 21} CH₄ generated can be used on-site to offset or eliminate energy cost, sold to a local industry or UGA, or, according to the Public Utility Regulatory Policies Act (PURPA), “a local utility is required to buy power generated at a landfill (which is a “Qualified Facility”) if the power can be sold at a price typically offered by the utility”.²² In the latter case, Georgia Power and/or Georgia Natural Gas would be the primary buyers, though there would be additional processes required to purify LFG to pipeline quality gas.²³

Under the Resource Conservation and Recovery Act (RCRA) and the EPA Criteria for

16 Bioreactor.org, “Information.”

17 Bioreactor.org, “Florida Bioreactor.”

18 EnergyJustice.Net, “Landfill Gas Fact Sheet.”

19 Bioreactor.org, “Florida Bioreactor.”

20 Ibid.

21 WM-Waste Management, “Waste Treatment Landfill Brochure.”

22 Green Power Market Development Group, World Resource Institute, <http://www.thegreenpowergroup.org/us.cfm> (accessed 5 January 2009).

23 Renewable Energy Annual 1996, “10. Growth of the Landfill Gas Industry,” United States Energy Information Administration/Department of Energy, <http://www.eia.doe.gov/cneaf/solar.renewables/renewable.energy.annual/chap10.html> (accessed 1 February 2009).

Municipal Solid Waste (40 CRF Part 258) which regulate bioreactors, landfills are only permitted to be retrofitted if they are certified under RCRA Subtitled D.²⁴ As stated above, under PURPA, local utilities are required to purchase landfill energy.²⁵ Because bioreactors are a new technology, the EPA is in the process of revising the MSW regulations with regard to the use of alternative liners (Subtitle D landfills are required to use EPA MSW-certified liners to line the bottom and top of the landfill) when leachate is recirculated. The EPA is in need of more information in order to revise the regulations, as well as to develop a standardized design for bioreactors, standardized operating procedures, and guidelines.^{26, 27}

Currently the Athens-Clarke County landfill is a traditional “dry-tomb” landfill. There are a total of three cells capable of accepting waste. The cell currently in use will be full in 2 years, and the two other cells, not yet constructed, have a combined lifespan of 4 years. Because it will take at least a year to construct a cell, by next year a decision must be reached that will determine whether to construct the other two cells or to develop 64-acres of the purchased 79-acre plot.²⁸ This proposal recommends that Athens-Clarke County Municipal Solid Waste Department install a facultative bioreactor on this 64-acre plot.

A Plan for the Future

Upon approval of the Athens-Clarke County landfill expansion, several new cells will be constructed on the newly purchased 79-acres immediately north of the existing 24-acre cell.

²⁴ United States Environmental Protection Agency, "Regulations," US EPA, <http://www.epa.gov/osw/nonhaz/municipal/landfill/leachate.htm> (accessed 12 December 2008).

²⁵ Green Power Market Development Group.

²⁶ United States Environmental Protection Agency, "Regulations."

²⁷ Bioreactor.org, "Florida Bioreactor."

²⁸ Girtz, Kelly. Interviewed by Malin Dartnell and Shanell Davis. Athens, Georgia, 20 February 2009.

This paper proposes that this cell be utilized as a facultative bioreactor. A Municipal Solid Waste Certified liner will line the bioreactor.²⁹ The rest of the bioreactor comprises a series of twenty-foot layers of waste covered by a perforated pipe inside of a layer of gravel, glass, or other filtering material. It will be installed layer by layer as waste is added. Ideally, as the waste breaks down and is neutralized, it will create room for more waste to be cycled through, essentially converting the landfill from a “waste disposal facility to a waste treatment facility.”³⁰

The decomposition process will produce methane-rich landfill gas, which will contain up to approximately 50% methane.³¹ This gas will be captured, treated on-site, and piped nearly eight miles to the University of Georgia, where it will be used in a gas powered boiler that will replace the coal-fired boiler currently being used for the majority of the University's heating and energy needs.³²

Bringing About Change

With the support and sponsorship of Commissioner Kelly Girtz, this proposal will be brought before the Waste Reduction Committee. The Waste Reduction Committee was commissioned by the mayor in February of 2009 to evaluate the solid waste reduction in Athens-Clarke County. The committee is headed by Commissioner Kelly Girtz and Commissioner Doug Lowry and consists of representatives from Athens-area schools, industry,

²⁹ Bioreactor.org, "Bioreactor.org Home", Hinkley Center for Solid and Hazardous Waste Management, http://www.bioreactor.org/video/BioreactorHIGH_8-17-08a.mov (accessed 12 December 2008).

³⁰ Ibid.

³¹ EnergyJustice.net.

³² University of Georgia Office of Energy Services, "Go Green at UGA," UGA Physical Plant Division, http://www.uga.edu/energy/news/article_35.html, (accessed 1 February 2009).

community, private haulers, and the University of Georgia.³³ If accepted by the Waste Reduction Committee as a feasible course of action to increase the life of the new cell, the Waste Reduction Committee will make a formal recommendation to the full body Mayor and Commission. At the same time, the University-County Relations Committee, the communication body between the University of Georgia and Athens-Clarke County, will also deliberate the feasibility of this proposal and make formal recommendations to their respective full bodies. Finally, they would draft a formal agreement.

The first question that will need to be answered is who will pay for the construction of the bioreactor, pipeline, and new gas boiler. This proposal recommends that UGA provide the funds to replace the current coal-burning boiler with a gas-powered boiler, that ACC procure the funding for the construction of the bioreactor, and that the cost of the pipeline be divided between UGA and ACC, although this proposal does not recommend a specific percentage breakdown.

Sources of funding open to ACC can be found on the local, state, and federal levels, as well as through private industry. According to Jim Corley, the Solid Waste Director, the ACC-SWD has already been receiving calls from private companies willing to finance the development of the landfill gas from the new cell in return for the carbon credits.³⁴ Other options that would allow ACC to keep the carbon credits include submitting this proposal as a Special Purpose Local Option Sales Tax (SPLOST) project in 2010, and appropriating funds from the Solid Waste Department.³⁵ Appropriating funds from SWD would potentially result in increased tipping fees in the short term. Financial aid could be requested from the state's

33 Girtz, Kelly. Follow-up Interview by Malin Dartnell and Shanell Davis. Athens, Georgia, 23 March 2009.

34 Corley.

35 ACC Online, "SPLOST - Special Purpose Local Option Sales Tax," Athens-Clarke County Georgia, <http://www.athensclarkecounty.com/splost/index.htm> (accessed 1 February 2009).

general fund, but there is a strong likelihood that there will not be funding available through the state due to the current recession. Potential federal sources of funding are available through the EPA and President Obama's new economic stimulus package, under the Energy Efficiency and Conservation Block Grant.^{36, 37}

The next step is to determine who will construct the pipeline and bioreactor. The Mayor and Commission will place the job out to bid. We recommend using a local construction firm, but according to "local and state code, there is not an allowance for local construction firm preference".³⁸ Once the bid is returned and accepted by the Mayor and Commission, the projected cost can be determined and construction can begin.

As previously mentioned, ACC's current landfill will reach capacity in a few short years. Because of this, \$750,000 was spent to acquire 79 acres of land that will be tied into the current 24 acre cell, and \$250,000 was spent to complete a site suitability report.³⁹ Pending approval from the Mayor Commission and EPD, the location of the bioreactor has already been determined.

In order to transport the gas from the landfill to the UGA Physical Plant, approximately 8 miles of pipeline will have to be constructed under EPA regulations.⁴⁰ UGA's Office of Energy Services, the ACC-SWD, and the construction firm will have to determine where the pipeline will run, in an effort to have the least impact on the environment and the citizens of the county.

36 West, Larry, "U.S. Economic Stimulus Package Includes Billions for Energy and the Environment," About.com, http://environment.about.com/od/environmentallawpolicy/a/econ_stimulus.htm (accessed 20 March 2009).

37 Energy Efficiency and Renewable Energy, "Energy Efficiency and Conservation Block Grant Program," United States Department of Energy, <http://www.eecbg.energy.gov/#le1> (accessed 30 March 2009).

38 Girtz, Kelly. Follow-up Interview by Malin Dartnell and Shanell Davis. Athens, Georgia, 23 March 2009.

39 Corley.

40 Ibid.

Good Things Come to Those Who Act

The implementation of a bioreactor in Athens-Clarke County will have many direct effects, both quantitative and qualitative, on the residents and institutions of the county, such as the University of Georgia. While much of the cost of the program will be covered by federal grants and the revenues collected from energy sales, there may be some initial costs that ACC Solid Waste Division will have to supplement. In addition, those that live in the area immediately surrounding the landfill will be able to see the facility, which could potentially lower property values in the area.

On the contrary, when the landfill gas is sold, ACC waste ratepayers will benefit financially, as sale of the gas will prevent tipping fees from rising. Alternatively, the revenue could finance other waste-reduction efforts.⁴¹ The operational and long-term landfill maintenance costs will be reduced, eventually decreasing the cost of curbside pick-up. The life of the landfill will be extended, and the new program will create jobs that will boost the local economy. By tapping the gas that will otherwise be released into the atmosphere, the program will reduce odor emissions from the landfill and improve air quality in the surrounding area. In addition, ACC residents will encounter less tangible benefits from the program. The implementation of a comprehensive sustainable waste management system, especially involving a technology as forward-thinking as a bioreactor, will elicit press coverage across the region, furthering the progressive reputation of the county and the University of Georgia. Moreover, the ACC community will benefit from the knowledge that they are helping to cut

41 Corley.

back on greenhouse gas emissions.

The installation of a facultative bioreactor can accomplish two goals that will result in a significant decrease in the cost of managing and maintaining a landfill. The first and most relevant concern for ACC that a facultative bioreactor will solve is the question of future expansions. One of the main purposes of a bioreactor is to extend the life of the landfill by increasing its vertical space by 15-30% once the waste is degraded and stabilized.⁴² This process usually takes between 5 and 10 years as opposed to the 30 to 50 years required for a traditional dry tomb landfill.^{43, 44} The life extension will lead to an increase in revenue over the long term and will reduce, if not eliminate, the need to horizontally expand.

Secondly, a bioreactor will decrease air and groundwater pollution. By enhancing the natural process of decomposition, a facultative bioreactor will not only allow the ACC MSWD to harness CH₄ emission, but it could also potentially decompose volatile organic compounds (VOC), non-methane organic compounds (NMOC), and inorganic compounds, such as dioxins and furans, found in MSW facilities.^{45, 46} Groundwater pollution will decrease because the leachate will no longer be stagnated in the bottom layers closest to the groundwater table. The leachate will be treated on site and recirculated continuously throughout the landfill to achieve optimal moisture.⁴⁷

The University of Georgia will also see significant positive effects. The new program

42 Bioreactor.org, "Information."

43 Bioreactor.org, "Florida Bioreactor."

44 Green Power Market Development, "Corporate Case Studies: Interface," World Resource Institute, <http://www.thegreenpowergroup.org/wmv/landfillgas.wmv> (accessed 19 November 2008).

45 Ewall, Mike, "Primer on Landfill Gas as 'Green' Energy," Energy Justice Network (2000), <http://www.energyjustice.net/lfg/> (accessed 11 December 2008).

46 Girtz.

47 Bioreactor.org, "Florida Bioreactor."

will open up incredible research opportunities for students and faculty. The University could work in conjunction with the University of Florida and the University of Central Florida, researching to help create standardized designs, operation procedures, and guidelines for bioreactors. The gas collected from the facility could eliminate the University's need for the coal-fired boiler that it currently uses for its heat and energy needs.⁴⁸ Replacing the coal-fired boiler will result in improved air quality for the county. In addition to emitting over 500 tons of sulfur dioxide and ten tons of hydrogen chloride per year, the boiler is a major contributor to the 110 pounds of particulate matter that the University emits per year, according to the Athens Banner Herald and the University Office of Energy Services.⁴⁹ Replacing the coal-fired boiler with a gas-powered boiler will eliminate such emissions. Additionally, disposing of the ashes from the 16,000 tons of coal that the university burns each year has presented a huge problem, since the two closest landfills to the university (the Athens-Clarke County landfill and the Barrow County landfill⁵⁰) refuse to take the waste. This causes incredible transportation costs which will also be eliminated by the use of gas collected from the proposed bioreactor.

The same benefits that Athens-Clarke County will see will be projected to the United States. Most importantly, the program will cause a 60-80% reduction of methane emissions from the landfill. This figure by itself does not seem as though it would have an extreme effect on the atmosphere. It would however join the ranks of other bioreactors across the country, which do the work of approximately 24 million acres of pine or fir forests, which equates to the removal of the annual greenhouse gas emissions from more than 19 million passenger vehicles.⁵¹ The landfill gas as an energy source will offset the use of nonrenewable energy

48 University of Georgia.

49 Ibid.

50 Corley.

51 United States Environmental Protection Agency, "An Overview of Landfill Gas Energy in the United States", US

sources that will continue to benefit the global community.

Obstacles to Hurdle

Potential challenges that may need to be confronted throughout this process include, but are not limited to: the site purchased not being approved, a WTE facility being dismissed as unfeasible, the choice of a bioreactor and the type recommended being called into question, and disputes over appropriate funding. This proposal will address each of these in turn.

According to Jim Corley, if the land purchased for construction of new cells is not approved, ACC Landfill will close in approximately 6 years and the county will have to ship its waste to another landfill.⁵² This will lead to increased fees across the board due to the cost of transporting and dumping the waste in another county's landfill. We do not recommend this course of action because it will make ACC subject to the requirements of another county that does not have to take the community's needs into consideration. The development of the 79 acres purchased in July of 2008 must be approved to avoid this outcome.

Should the feasibility of a landfill gas to energy (LFGE) project be dismissed, the necessity of one will not be ignored for long. EPD mandates that any landfill emitting over 50 Mg/year of LFG be capped and flared or sold to an industry.⁵³ The new site would eventually reach that point and prolonging the installation of a LFGE facility would be economically and socially irresponsible. By initiating this project before the landfill reaches the maximum mandated level of emissions, ACC can apply for carbon credits that can be traded on the

EPA, <http://www.epa.gov/landfill/docs/overview.pdf> (accessed 12 January 2009).

52 Corley.

53 United States Environmental Protection Agency, "Fact Sheet."

Chicago Climate Exchange. Delaying construction of a LFGE facility could potentially deprive ACC of a source of revenue and/or the carbon credit incentives that private industries are seeking in exchange for funding the construction of a LFGE facility.

This proposal recommends a bioreactor, specifically a facultative bioreactor, rather than the other methods of converting waste to energy or landfill gas to energy. The present research determines that a bioreactor solves the problems of both emissions and expansions at a more economically feasible cost than the other options, which are either extremely costly, or solve only the problem of emissions. A facultative bioreactor is recommended over an aerobic type because it is a sustainable method of waste management that will generate revenue to support the maintenance and management of the facility. An aerobic bioreactor will not produce a marketable product. Though an aerobic bioreactor would be more environmentally friendly because the end products are oxygen and soil, without a method to pay for the facility in the long term, the feasibility of this project could be diminished (reference Table 1).⁵⁴

The most obvious challenge to this project will be providing funding while keeping the cost to the community low. As mentioned earlier, there are various avenues available for funding this project, but there is a monetary cost for every ounce of waste produce and dispose. All attempts will be made to lessen the financial impact to the citizens and industries of Athens-Clarke County, but an increase in certain fees may follow whether or not this proposal is accepted. In the long run, however, the future costs of traditional landfills will greatly outweigh the short-term costs of establishing a bioreactor.

Conclusion

54 WM-Waste Management, "Waste Treatment Landfill Brochure."

One of the top questions today is what to do with our waste. Traditional “dry-tomb” landfills are no longer a feasible long-term option for waste management and for most counties the cost of shipping their waste is not economical. These problems are leading to the shift in how waste management is perceived and the creation of innovative technology. Bioreactors are one such technology that can effectively shift waste disposal to waste management in Athens-Clarke County, GA, as well as, solve an energy problem for the University of Georgia. Within the next five years, both ACC’s waste issues and UGA’s energy problems will reach their pinnacle and a decision will have to be against a backdrop of more stringent environmental regulations. By addressing these issues today, through an environmentally sustainable lens, they will reap the benefits, both economically and socially, of voluntarily incorporating innovative and sustainable technologies into the county.

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http://environment.about.com/od/environmentallawpolicy/a/econ_stimulus.htm
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