Utilization of Wasted Energy

# Proposal

# Kai Chin

# 3A

#

Abstract

The modern world is filled with an immeasurable amount of waste; the problem with waste has led to numerous problems such as water pollution, increase emission of greenhouse gas and many more. One solution that could drastically reduce these impact caused by waste is by harvesting methane gas from organic waste compound. Once it is mix with water and the gas can be used for cooking and heating. Some of the methods used for this study are: collecting information from a scholarly article, institution and receiving guidance and advice from a mentor that is an expert in this field of study. The information collected from various sources indicates that harvesting energy from organic waste to be the most cost effective and beneficial to the environment. However, the downside to this is that it requires regular maintenance and further research has to be conducted to maximize the energy output of this method to ensure maximum efficiency. All in all, harvesting energy from organic waste is the best method to reduce impact on climate change and to potentially solve problems related to waste management.

Introduction

One of the major issues in our modern world is the environmental crisis that relates with the energy policy used in society. This research is designed to address questions that could potentially benefit society in the discovery of the ideal energy that is both environmentally friendly yet with no detriment to our current standard of living. Therefore, this particular research paper is challenging society to ask to what extent is the best way to optimize the use of wasted energy in society. Furthermore, this research paper also seeks to discuss the process of harvesting energy out of organic waste products and to identify some of the positive and negative aspect of this technology. Additionally, this paper sought to educate and spread awareness of anaerobic digestion of biomass because any form of support from the public is accounted for.

This research paper is particularly design to analyze the various arguments proposed by various scholars and experts in this field. It is imperative to understand the underlying facts beneath the various energy policies and system because it is the key factor to unlock the ideal solution to utilize the use of wasted energy. Then, an ideal method can be devise to maximize the output energy to reduce human consumption on resources to hopefully stagnate the environmental impact that is currently undergoing.

After conducting extensive research on numerous green technologies that is currently used throughout the world, it is predicted that harvesting energy from organic waste compound to be the most feasible and efficient form of green technology currently available. Statistics derived from numerous research further indicates that recovering half of the total wasted energy could reduce one third of the issues associated with fossil fuels with no effect to our current lifestyles. For the purpose of this research, this paper will be focus on harvesting energy from organic waste product.

Human development during the past century began to grow exponentially, and human waste began to increase causing the ecosystem to show signs of disturbance. Urban growth has infused immeasurable amount of pollutants, gasses and waste that are negatively affecting our planet’s climate. One of the many factors of this problem is the lack of cooperation amongst the international community to address this problem, such as the Kyoto protocol which proves to be a failure as the world’s largest energy consuming giant did not ratify this protocol. Secondly, the amount of automobile in the world is also playing a major role in climate change because it is releasing large amounts of Carbon dioxide gas into the atmosphere and government officials are not addressing this issue effectively. Shockingly, the current recession is actually benefiting the environment because factories are reducing their production rate thus reducing carbon dioxide, employees drive less and turn down their furnaces to save gas and struggling corporation cut down on travel. (Owen) In essence, prosperity is the principal source of greenhouse gasses.

 On an annual basis, buildings in the United States consume 39% of America's energy and 68% of its electricity. Furthermore, buildings emit 38% of the carbon dioxide (the primary greenhouse gas associated with climate change), 49% of the sulfur dioxide, and 25% of the nitrogen oxides found in the air. Currently, the vast majority of this energy is produced from nonrenewable, fossil fuel resources. (WBDG)

America is one of the largest energy consumers as of today and the DOE (Department of Energy) estimates that it use about one hundred quadrillion btus(quads) of primary energy a year and many of that energy is lost due to the second law of thermodynamics which state that energy flow from being more concentrated to less concentrated. Energies that are lost are then turn into heat. Many of this energy waste is lost through transportation, electricity, industry, residential and commercial buildings, power generation and solid waste. When adding up all of these factors there will be an estimate of about one hundred quads of initial input energy but only forty quads is actually used. These numbers suggested that our energy production system is highly ineffective which means that there is a huge room for improvement within this field, and recovering just half of this total wasted energy could potentially mitigate the issues associated with fossil fuel by one third without jeopardizing our standard of living. Instead of prioritizing on green energy products that requires decades more to perfect, the governments ought to redirect their focus towards more a more feasible goal such allocating funds toward the research and development of green technologies. (Casten)

 According to a study conducted by the international energy agency investment for Research and Development for renewable energy resources skyrocket during the 1980s. This was inadvertently caused by an embargo proclaimed by OPEC in response to the United State’s decision to pledge support for Israel’s military during the Yom Kippur War. The oil prices rose 400% as a direct result of this embargo and oil production in the states could not keep up with the demand for oil within. (CleanTech) As a result of this, the U.S. national security is under serious threat as the military would not be able to function with maximum effectiveness without adequate fuel supply. This in turn led to the establishment of the Department of Energy which is specifically founded to cope with this issue. In addition to that, the National Energy act of 1978 was also created in response to this issue and in turn billions of dollars were invested into renewable research and development. (NACS) Funds are more likely to be allocated for new developments during times of crisis instead of prosperity. Ironically, economic prosperity plays a crucial role in reference to the funding for green technology and impact on the environment. In conclusion, it is more beneficial to the environment during times of crisis, in a sense that is related to the development of Penicillin in World War I because anti-biotic medicine would have never existed if it wasn’t for the war.

However, human development cannot simply be put on halt just for the sake of the environment. Instead, a compromise has to be made between international leaders to pledge its support for the most efficient green technology that would have the least amount of impact on the environment.

 India’s Waste Problem

Unlike America, India is currently undergoing a major sanitation crisis dealing with surface water contamination. The majority of the country’s water supply is currently a biohazard as 75% of its surface water is infested with human and agricultural waste. The problem lies in the fact that six hundred and sixty million of its people continues to practice open defecation, the feces that are left behind would eventually be washed into one of the many rivers that supply its population’s basic water necessity. A study conducted by the UN indicates that each gram of feces can contain ten million virus particles, one million bacteria, one thousand parasite and one hundred parasite eggs. A huge percentage of its population is at risk of consuming human feces especially the ones dwelling in cities. Consumption of contaminated water could lead to common diseases such as Cholera and Typhoid. According to the United Nations Children’s Fund, it is estimated that one thousand children younger than five die of diarrhea, hepatitis-causing pathogens and other sanitation related issue. This situation is likely to stagnate the Indian economy from further growth if the problem persists as large numbers of its population is affected by illness and death due to poor sanitation. India is currently mounting a massive campaign to tackle its sanitation crisis by building latrines and educating its population about the importance of maintaining a good hygiene. (Gale)

Every year in India, more than two hundred million tons of human sewage goes uncollected and left untreated thus polluting the environment. (Gale) Fecal matter has great potential to solving our energy crisis and there is a near infinite supply of fecal matter at our disposal. Biomass could be the potential key to solve our energy crisis in the future because it’s impact on the environment is minor.

Poor sanitation in a country cannot only stagnate economic growth in a country but it could also put a major strain on its surrounding environment as pollutants contaminate nearby ecosystem thus disrupting the local habitat in the region.(Gale) As Ghandhi once said, “Sanitation is more important than political independence”. This is true in a sense because there is no point in gaining political freedom if people continue to live in uninhabitable conditions.

Anaerobic Digestion

 Much of the world’s attention is focused on reducing carbon dioxide emission which is the greenhouse gas with the most profound and lasting effect on Earth’s heat exchange system. (Pettus) However, one of the most powerful and important greenhouse gases is largely neglected; this greenhouse gas is called methane. Methane gas has a significantly shorter live span than carbon dioxide and it is only expected to exist from eight to twelve years. Despite its short lifespan it has greatest impact on the global warming on the planet as a whole, it traps twenty five times more heat than carbon dioxide over a 100 year period and its impact is also seventy two times greater than the total amount of carbon dioxide in the atmosphere. (Pettus) Unquestionably, steps has to be taken to reduce the amount of methane gas in the atmosphere and one of the most practicable way to do so is by harnessing methane gas from fecal matters to use as a source of energy to power human civilization.

 Methane is an extremely flammable gas that contains one atom of carbon and four atoms of Hydrogen. The gas is a major component of natural gas and is mainly used in household for purposes such as cooking and heating. (Energy Savers) Methane gas is most commonly found in fossil fuel, animal husbandry, rice cultivation, biomass burning and waste management.(Sources of Emission) As of this point, methane gas released by livestock’s manure is left uncultivated and this abundant source of energy is left to waste instead of being harnessed to make efficient use of. Methane or biogas can be recovered through a process known as anaerobic digestion or bio-digestion by breaking down organic materials in the absence of oxygen. (Energy Savers)

 Biogas harvested from manure is a relatively inexpensive and is an ultra green form of renewable energy because not only can it mitigate the impact of climate change as the process traps methane gas from being released but it can also be used to power homes and used as an odorless fertilizer.(Glass) In addition to that, biogas can also reduce water contamination as it reduces manure from entering various bodies of water. One of the many methods used to harvest biogas is the “Salchica” type container. The Salchica bio-digester is relatively cheap and is suitable for low income families, the device itself is empty of technology and everything that happens inside is a natural process which the bio-digester simply takes advantage of. The device consists of a flexible plastic tube that is used to store methane and it is collected through a pipe running from the container that stores the manure that will eventually go through the process of anaerobic digestion to recover the methane that resides in it. (Biodigesters)

 Another method to harvest methane from waste is the floating dome bio-digester which is also used in Munich’s zoo to harvest animal dung. (Glass) Essentially there are four components to a floating dome digester: the digester tank, the floating dome, the influent chamber (feed pit) and the effluent chamber (outlet pit). The digester tank consists of a concrete base with concrete block walls. On one side of the tank, a pipe enters from the influent chamber; on the other, a pipe exits to the effluent basin. Cast into the tank's concrete base are three protruding rebar posts, which align with three PVC tubes constructed into the floating dome. The alignment of these two sets of parts ensures that the dome floats straight up and down within the tank. The floating dome consists of a galvanized iron and sheet metal frame, covered in impervious fiberglass. The dome is the storage vessel for the gas produced. As gas generated during anaerobic digestion, the dome floats upward. As gas is used, the dome recesses downward into the tank. The influent and effluent basins are also constructed of concrete block with a concrete base. The water/waste mixture is added to the system via the influent basin; digested liquid exits via the effluent basin. (Biodigesters)

 Although, this process is relatively simple and inexpensive to cultivate, it cannot be used throughout the world because the process is highly sensitive to temperature change. Decomposition and biogas production thrives and occurs more rapidly in the thermophilic range of 130°F and biogas production began to fall in the mesophilic range between about 103° and 125°F and gradually from 95° to 32°F. (Energy Savers) In addition to that, the anaerobic process requires a significant amount of time to maintain because it requires a continuous source of organic materials or waste in it. Waste has to be added each day to be mixed with water, then ground to a liquid state. Also, bio-digested sludge has to be removed everyday to be replaced by new sludge. (Biodigesters)

Pros

 Anaerobic digestion of biomass offer two important benefits of environmentally safe waste management and disposal, as well as the generation of clean electric power. (Zafar) Additionally, it could also reduce reliance on energy imports as it generates premium quality renewable fuel. Lastly, it also plays a pivotal role in the sense of tackling climate change as the methane that would eventually be released into the atmosphere would be used to produce energy. (Zafar) Although the concentration of methane in the atmosphere is significantly less than carbon dioxide, one molecule of methane is twenty one times more effective at trapping heat in the atmosphere than carbon dioxide over a one hundred year time period. (EPA)

Cons

 According to the information provided by instructor Greer from Tallwood High School some of the negative impact of using anaerobic digestion of biomass is that inappropriate treatment of the waste compound could be pose as a biohazard to the worker’s health. Also, using biogas could possibly lead to temporary unemployment as the current energy producers are likely to be replaced by the new green energy producers. Despite, its process of removing methane from the atmosphere, carbon dioxide will still be released regardless, if it involves combustion. (Greer)

Profitability of Fecal Matter

 Organic waste materials can not only be used to reduce energy cost but can also be used to make a profit. This process not only empower farmers to earn a profit from waste that would eventually go to waste but it also provides them with an odorless fertilizer that can be used or sold on crops that reduces the need for chemically produced fertilizers. (Mahoney Google) In addition to that, harvesting methane from animal dung could also reduce methane emission into the atmosphere as the gas is trapped and used as a source of fuel. According to a study conducted by the Environmental Protection Agency it indicates that the United States anaerobic digesters can potentially cut methane emission by fifty one thousand metric ton which is equivalent to one point one million tons of carbon dioxide. Methane power could also replace about two hundred and sixty four thousand tons of carbon dioxide emission from fossil fuels which could play a significant role in delaying the effects of climate change. (Mahoney)

Animal waste is a major problem in regards to accelerating climate change because not only does it release a significant amount of methane gas that is more efficient in trapping heat than carbon dioxide, but it also pollute rivers, streams and groundwater. Once these waste materials contaminate the various bodies of water it will increase the nutrient density in the water thus promoting excessive plant growth and decay which could cover the entire surface of the water and prevent any form of sunlight from penetrating. When plants die they sink to the bottom of the where they will be decomposed. The decomposition process uses oxygen which could disrupt oxygen supply in the water and suffocate marine habitat. This process is known as Eutrophication and it is currently a growing concern in many parts of the world due to the increase in agricultural growth to supply the demand of the growing human population.

Rwanda Prison

 Trends have been emerging throughout the world indicating that individuals and government officials are becoming more aware of the availability of green resources that are at their disposal. A prime example would be the Rwandan government’s effort to convert its energy dependence from using firewood to biogas. Biogas is one of the few alternative energy sources that are cheap, efficient and accessible. At Nsinda Prison in Rwanda, a system has been developing to utilize human and cow dung to power 75% of the prison’s energy demand. This process is estimated to have reduced 85% of its energy cost and saved about one point seven million U.S. dollar on energy cost. Using fecal matter to power the prison is a great way to reuse organic compounds that would eventually go to waste or harm its surrounding environment because once the contents contaminate the water way it would lead to eutrophication and disrupt the marine ecosystem in the area. (BBC)

 In order to harvest the methane gas from the waste products, it has to go through a process known as anaerobic digestion where organic compounds are broken down.(Biodigesters) Human feces are not rich enough to produce premium gas which is why cow dung is combined into the combination to create the ideal gas. The two wastes are combined with water and stored in one of twelve digesters which hold about one hundred cubic meters of biogas. In addition to that, the waste is also used as fertilizers within the prison walls to grow vegetables which could further reduce the cost of maintaining the prison as food is grown locally. Rwanda is currently setting the trend for nations throughout the world as one of the successful nation to create self sustainable prisons. (BBC)

Conclusion

 Humans are imbedded with the idea of obsolescence in their mind in which they have the tendency to buy, discard and buy again with no thoughts of reusing. This wasteful ideology was not simply adopted recently but it was passed down upon from the 1800s and slowly evolved to its current stage. (Tamminen) Over the past century, human population began to increase exponentially which in turn raises the demand in agricultural product. This increase in demand produces a greater amount of waste thus adding additional stress on the environment. Every day immeasurable amount of waste is left untreated in the open because people were blinded by the sight of greed in which they constantly sought to earn more money. The waste that was left behind would eventually be carried into a watershed and contaminate its water thus disrupting the marine ecosystem in the area. (Gale)

 In addition to water contamination, some of the major problems thwarting the growth of green technology are the dependence on fossil fuels and governmental policies that grant subsidies to Fossil Fuel Corporation maintain cheap gas prices. (Shukla) Subsidies granted to fossil fuel companies not only decrease funds for that are intended to be used for researching and development for green technology but it could also encourage further use of fossil fuels. Public outcry for cheap gas is another aspect that inhibits and delays the development of green technology.

 Neo-Marxians believe that “modernization is the key force that drives environmental degradation”. The Neo-Marxian’s believes is based on Karl Marx’s theory on metabolic rift where he describes how humans are all part of nature and when people become disconnected from their physical and emotional relationship with nature. They began to lose respect for it. (Leufstedt) Public awareness and education is crucial to the future of our environment and it is imperative to reverse the metabolic rift and take responsibility for our actions before the impact becomes irreversible.

According to the data proposed by Richard York’s research we can conclude that population growth is the key force in driving the expansion of energy production and that the age group of the population also plays an important role as nations with the highest population that fits in the productive age group has a positive influence on energy production which is probably due to greater levels of consumption and labor force participation in this age group. (York)

 The growing use of digestion technology as a method to harness energy and dispose excreta has greatly reduced its environmental and economical impact. (Zafar) Switching to anaerobic digestion of biomass technology can deliver several positive benefits which is to decelerate eutrophication in various body of water, to reduce methane greenhouse gas in the atmosphere and to harness energy that would eventually go to waste.

All in all biogas is an excellent source of renewable energy, it is cheap, ultra green and requires little to no technology to cultivate. This process is excellent for impoverished or third world countries because it could not only be the key to solving our energy crisis but it is also economically beneficial to individuals and the country as it could significantly reduce energy cost. However, it has not been perfected and the concept is still relatively new and funds should be allocated for research and development to maximize efficiency for this project. Action has to be taken to revert the damage inflicted on the environment and it is imperative to do so with haste because time is running out and that the prosperity of the human race depends on the well being of the environment.

"Biodigesters." *Biodigesters*. Appropriate Infrastructure Development Group. Web. 19 Dec. 2011. <http://www.aidg.org/biodigesters.htm>.

"Energy Savers: How Anaerobic Digestion (Methane Recovery) Works." *EERE: Energy Savers Home Page*. Web. 19 Dec. 2011. <http://www.energysavers.gov/your\_workplace/farms\_ranches/index.cfm/mytopic=30003>.

"Sources and Emissions | Methane | Climate Change | U.S. EPA." *US Environmental Protection Agency*. Web. 19 Dec. 2011. <http://www.epa.gov/outreach/sources.html>.

BBC News - In Pictures: Rwanda's Poo-powered Prisons." *BBC - Homepage*. BBC, 17 Dec. 2011. Web. 21 Dec. 2011. <http://www.bbc.co.uk/news/world-africa-16203507>.

Casten, By Sean. "How Much Energy Does the U.S. Waste? | Grist." Grist | Environmental News, Commentary, Advice. Grist, 11 Sept. 2009. Web. 21 Nov. 2011. <http://www.grist.org/article/2009-09-11-how-much-energy-does-the-us-waste>.

CleanTech. "OPEC’s Price Hike Spotlights Renewable Energy | Technica." Technica Communications. Technica, 16 Oct. 2011. Web. 21 Dec. 2011. <http://technicacommunications.com/dailycleantech-opec-oil-embargo-renewable-energy/>.

EPA. "Science | Methane | Climate Change | U.S. EPA." US Environmental Protection Agency. Environmental Protection Agency, 22 June 2010. Web. 21 Dec. 2011. <http://www.epa.gov/outreach/scientific.html>.

Gale, Jason. "Bloomberg." *Bloomberg - Business & Financial News, Breaking News Headlines*. Bloomberg, 3 Mar. 2009. Web. 21 Dec. 2011. <http://www.bloomberg.com/apps/news?pid=newsarchive>.

Glass, Nick, and George Webster. "Elephant-poo Power Electrifies Zoo - CNN.com." *CNN.com - Breaking News, U.S., World, Weather, Entertainment & Video News*. CNN, 11 Oct. 2011. Web. 21 Dec. 2011. <http://www.cnn.com/2011/10/10/world/europe/elephant-dung-biogas-munich/index.html>.

Greer, Erin. Personal Interview. 21 December 2011

Leufstedt, Simon. "Karl Marx and the Metabolic Rift." Green Blog. 19 Feb. 2010. Web. 22 Dec. 2011. <http://www.green-blog.org/2010/02/19/karl-marx-and-the-metabolic-rift-theory/>.

Mahony, Melissa. "Google Takes Stink out of Pig Waste | SmartPlanet." *SmartPlanet - Innovative Ideas That Impact Your World*. Smart Planet, 12 Sept. 2011. Web. 21 Dec. 2011. <http://www.smartplanet.com/blog/intelligent-energy/google-takes-stink-out-of-pig-waste/8660?tag=header;header-sec>.

Mahony, Melissa. "Is Poop Power Profitable? | SmartPlanet." *SmartPlanet - Innovative Ideas That Impact Your World*. Smart Planet, 17 Oct. 2011. Web. 19 Dec. 2011. <http://www.smartplanet.com/blog/intelligent-energy/is-poop-power-profitable/9649>.

Marsh, Bill. "The New York Times Week in Review Image Wasted Energy." The New York Times - Breaking News, World News & Multimedia. The New York Times, 06 Apr. 2008. Web. 22 Dec. 2011. <http://www.nytimes.com/imagepages/2008/04/06/weekinreview/06revkin.html?ref=weekinreview>.

NACS 50th Anniversary - 1970s: Education." NACS 50th Anniversary: Celebrating 50 Years. NACS. Web. 21 Dec. 2011. <http://www.nacs50.com/decades/70s/>.

Owen, David. "Economy vs. Environment." The New Yorker. The New Yorker, 30 Mar. 2009. Web. 20 Dec. 2011. <http://www.newyorker.com/talk/comment/2009/03/30/090330taco\_talk\_owen>.

Pettus, Ashley. "Methane: Tapping the Untapped Potential." Global Methane Fund. Clean Air Task Force, Dec. 2009. Web. 22 Dec. 2011. <http://www.globalmethanefund.org/methane-untappd\_potential-12.01.09.pdf>.

Shukla, P. R. "Biomass Energy in India." E2 Analytics. The Social Engineer, Vol. 6, No. 2. Web. 20 Nov. 2011. <http://www.decisioncraft.com/energy/papers/ecc/re/biomass/bti.pdf>.

Tamminen, By Terry. "Made to Break Reveals the Roots of Our Throwaway Culture | Grist." Grist | Environmental News, Commentary, Advice. 29 June 2009. Web. 22 Dec. 2011. <http://www.grist.org/article/grossman1>.

WBDG. "Optimize Energy Use | Whole Building Design Guide." WBDG - The Whole Building Design Guide. National Institute of Building Science, 16 Aug. 2011. Web. 21 Dec. 2011. <http://www.wbdg.org/design/minimize\_consumption.php>.

York, Richard. "Structural Influences on Energy Production in South and East Asia, 1971-2002." Jstor.org. Springer, 11 Oct. 2011. Web. 22 Dec. 2011. <http://tidal-wave.wikispaces.com/file/view/Structural%20Influences%20on%20Energy%20Production%20in%20South%20and%20East%20Asia%2C%201971-2002.pdf>.

Zafar, Salman. "Anaerobic Digestion of Biomass." Alternative Energy News. Alternative Energy, 25 Aug. 2008. Web. 21 Dec. 2011. <http://www.alternative-energy-news.info/anaerobic-digestion-biomass/>.