ABSTRACT

Title of Document:	AGRONOMIC AND ECONOMIC VIABILITY OF *MISCANTHUS X GIGANTEUS* AS A NOVEL BIOFUEL IN THE MARYLAND CLIMATE
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Our study examined the effects of land quality and water-absorbent polymer on the growth of *Miscanthus x giganteus*. Our goal was to help utilize previously uncultivable land efficiently and meet U.S. energy goals. Currently, most U.S. biofuel is produced from corn, which requires arable land for growth and therefore significantly disrupts the production of food crops. We predicted that *M. x giganteus* would be able to thrive on marginal land, unlike corn, with the aid of a water-absorbing polymer. After growing *M. x giganteus* on both arable and marginal land, with and without the application of a polymer, we found that our crop grew better on the arable land. We also found that the presence of the water-absorbing polymer in the soil did not affect the growth of *M. x giganteus*. Finally, an economic cost-benefit analysis showed that growing *M. x giganteus* would not be a viable commercial enterprise, without the use of a commercial fertilizer and based on existing revenue and expense scenarios.

AGRONOMIC AND ECONOMIC VIABILITY OF *MISCANTHUS X GIGANTEUS* AS A NOVEL BIOFUEL IN THE MARYLAND CLIMATE

By

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Table of Contents

List of Tables

List of Figures

CHAPTER 1: INTRODUCTION

Introduction

The global economy faces the mounting problem of rising energy prices and shrinking fossil fuel supplies, brought into the spotlight of public policy by increasing awareness of the environmental consequences of fossil fuel use. Due to the decreasing suitability of traditional fuels, increased funding and research is being applied to alternative energy. Of these, biofuels are one of the most promising and currently researched types of alternative fuels (Hill et al., 2006). In the United States, the government has become more committed to increasing the use of biomass-based fuels in order to reduce the need for petroleum. To accomplish this, the U.S. Department of Energy and the U.S. Department of Agriculture have recommended that 30% of the country's petroleum use be replaced with renewable biofuels by 2030 (Perlack et al., 2005). It is estimated that nearly one billion tons of biomass annually will be needed to achieve this goal, with 998 million dry tons coming from agricultural lands (Perlack et al., 2005). Producing this amount of biomass annually is not possible without disrupting the food supply because land will be converted from food production to producing bioenergy crops (Perlack et al., 2005). One possible solution to this problem would be to grow bioenergy crops on marginal land, land not suitable for the cultivation of food stock, which is widely available in western and northwestern United States and the Midwest (Cassel-Gintz et al., 1997). The reduction in cost of land acquisition may be able to offset the reductions in biomass yield due to growing on marginal lands, if a suitably robust plant can be found. Additionally, marginal land is often located in drought areas. Cross-linked polyacrylamide (CLP) is a superabsorbent, water-absorbing polymer that has been shown to increase the growth and survival of plants under water stress conditions when it is incorporated in the soil (Abd El-Rehim et al., 2004). This product may aid in the establishment and production of biomass biofuels on less than ideal lands.

Moreover, alternatives to conventional biofuels, mainly corn ethanol, will need to be found. With corn ethanol production expected to plateau at 15 billion gallons by 2015, the Energy Independence and Security Act of 2007 states that 21 billion gallons of additional renewable biofuel must be produced annually from lignocellulosic ethanol and other biofuels derived from feedstock other than corn starch by 2022 (Sissine, 2007). Additionally, there is room for novel biofuels in areas outside of liquid transportation fuel, such as biomass used to supplement coal as a combustion fuel for electricity production.

One such alternative is *Miscanthus x giganteus*. *M. x giganteus* is a perennial grass native to East Asia and is a naturally-occurring sterile hybrid of *M. sinensis* and *M. sacchariflorus*, which indicates that there is no risk of the species becoming invasive. It has high nitrogen-use efficiency (Beale et al., 1996), and low water-usage requirements, making it a hardy plant even on poor land. It contains a high degree of cellulosic biomass, making it suitable as a potential biomass source for second generation biofuels, which produce liquid fuel from cellulose rather than starch.

Although *M. x giganteus* has been extensively grown in Europe, few studies have examined the bioenergy crop in the United States and none have studied the plant's growth on marginal land or with CLP, the polymer, in the soil. Therefore, to fill this gap, this study will examine the effect of marginal land, with and without the polymer incorporated into the soil, on the productiveness and energy content of *M. x* *giganteus*. The following questions will be addressed: how do the biomass yields of *M. x giganteus* compare with respect to the agricultural viability of the land and the presence of CLP in the soil? Is it economically feasible to produce *M. x giganteus* as a biofuel crop, as either a source of cellulosic biomass or as a solid combustible fuel? In order to answer these questions, one-year-old *M. x giganteus* were planted at two locations in Maryland: Woodstock, in a plot of arable land, and Brandywine, in a plot of marginal land. The plants were planted in 18 and 16 rows, respectively, of ten plants each, with the application of the polymer to every other plant. The aboveground biomass was harvested in the winter of every year of growth. Literature shows that early winter is a suitable time to harvest because less energy is needed to dry the plants and fallen leaves provide more nutrients to the soil the following spring (Amougou et al., 2011). The dry mass of the plants was measured in addition to the energy content, which was found using calorimetry. Soil tests were also performed to quantitatively determine the quality of the soil at each plot. A two-way ANOVA determined the statistical significance of differences between the dry weights and energy contents of the four levels of the independent variables. Our data were compared to existing calorimetric analyses, and evaluated with a cost-benefit analysis of *M. x giganteus* production on the different land types and with and without CLP. The analysis examined the economic feasibility of using *M. x giganteus* as an alternative bioenergy crop. It was anticipated that the plants with polymer in their soil would produce more biomass than those without. Moreover, it was hypothesized that the biomass production of *M. x giganteus* would be more than that of maize.

CHAPTER 2: LITERATURE REVIEW

Literature Review

Miscanthus x giganteus

Miscanthus is a genus of perennial C_4 plants that have undergone extensive testing as potential biomass crops in European field trials. C_4 plants, which use a four-carbon molecule as a shuttle to concentrate CO_2 during photosynthesis, are considered to have the highest theoretical photosynthetic efficiency and potential productivity of all plants due to significant suppression of photorespiration (Naidu et al*.,* 2003). This suppression leads C_4 plants to exhibit higher nitrogen use efficiency and thus require lower nitrogen inputs (Beale et al., 1996). C_4 plants make up 5% of the world's plant life and are mostly grasses native to hot, arid climates, while the remaining 95% of the world's plant life is composed of C_3 plants (Lambers et al., 2008). During C_3 photosynthesis, three carbon dioxide molecules are concentrated typically by a diffusion mechanism and converted to 3-phosphogylcerate by the Calvin-Benson cycle. However, the photosynthetic enzyme RuBisCO (ribulose-1,5-bisphosphate carboxylase oxygenase) is also capable of catalyzing a breakdown of ribuolose-1,5-bisphosphate (RuBP) in the presence of significant oxygen by its oxygenase activity. The destruction of RuBP, which is the product of photosynthesis, degrades it into a recycled phosphogylcerate and a metabolically expensive phosphoglycolate. This phosphoglycolate undergoes an extensive series of transport reactions to the peroxisome and the mitochondria to be recycled, which requires a net loss of carbon and ammonia. Suppression of this ammonia loss is the source of higher nitrogen use efficiency in C_4 plants. Photorespiration occurs most when plants have difficulty sequestering CO_2 away from O_2 effectively. C_4 plants solve this by incorporating CO_2 into another molecule, such as oxaloacetate, and shuttle it across a membrane into another compartment or neighboring cell, which is impervious to CO_2 and O_2. This saturates RuBisCO with CO_2 and effectively prevents it from catalyzing the oxygenase reaction, which requires elevated levels of O_2.

Miscanthus x giganteus is a perennial naturally occurring, sterile allotriploid hybrid of the grasses *M. sinensis* and *M. sacchariflorus* (Nishiwaki et al., 2011). All three species are found in Southeast Asia, with natural populations of *M. x giganteus*

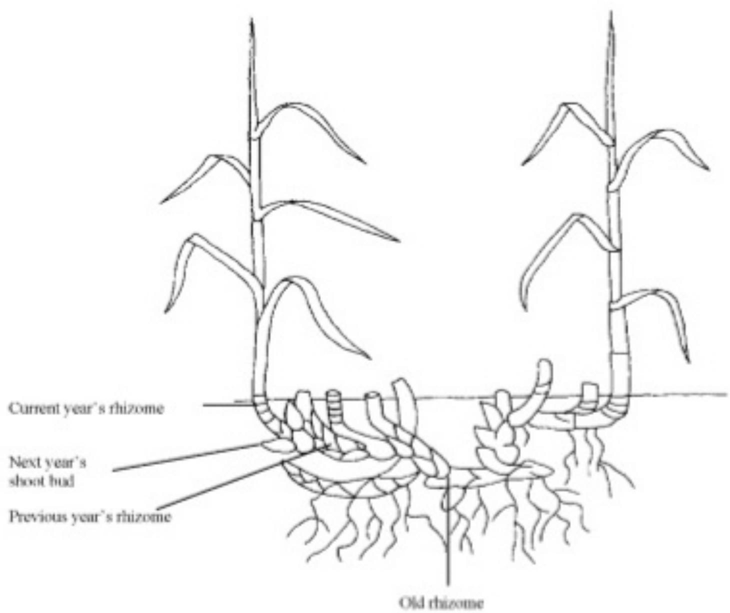


Figure 1. Rhizome of *M. x giganteus* (Christian et al., 2009).

being found in Japan. Because *M. x giganteus* is sterile, it propagates via rhizome (Lewandoswki et al., 2000). Between 86% and 90% of the belowground biomass is in the rhizome (Amougou et al., 2011) (See Figure 1; Christian et al., 2009). The rhizome of the plant stores nutrients, such as nitrogen, during the winter when the plant becomes dormant. In the spring, nitrogen and other nutrients move out of the rhizome and into the shoot of the plant; at the end of the growing season, nutrients move back to the rhizome. This ability of *M. x giganteus* allows the plant to use nitrogen and other nutrients more efficiently, giving the plant low nitrogen-fertilization requirements (Amougou et al., 2011). The root density decreases dramatically after 30 cm of soil depth, although roots can reach depths of up to 250 cm (Neukirchen et al., 1999). The tremendous depth of the roots could allow for the plant being able to uptake more nutrients and water in soils that contain low concentrations of these resources.

Figure 2. 3-year-old *M. x giganteus* planted in Woodstock, MD. The man is 1.8 m tall.

Reaching maturity in approximately 3 to 5 years, *M. x giganteus* can reach stem heights of up to 3.50 meters (Greef and Deuter, 1993) (Figure 2). Previous studies of *M. x giganteus* in Europe have shown yields above 30 t ha^{-1} $year^{-1}$ with irrigation and 10-25 t ha^{-1} $year^{-1}$ without irrigation (Lewandowski et al., 2000). Most of these studies included nitrogen fertilizer, although not all of them observed an effect on the yield due to the fertilizer. Adding to the benefits of *M. x giganteus* as a potential biofuel crop is that its profitable lifetime may be up to 15 to 20 years

(Lewandowski et al., 2000).

As opposed to other biomass crops like maize and switchgrass, *M. x giganteus* has a much higher biomass yield, lower costs and maintenance, and fewer fertilizer and chemical requirements (Khanna et al., 2008). In side-by-side field trials conducted in Illinois, *M. x giganteus* had twice the average leaf area and was 59% more productive than grain maize (Dohleman et al., 2009). Also according to this field trial, *M. x giganteus* yields were three to four times higher than those of switchgrass, and the breakeven cost of *M. x giganteus* was less than two-thirds the breakeven cost of switchgrass. This was hypothesized to be due to the fact that leaf photosynthesis in *M. x giganteus* was almost 40% higher than in switchgrass, and that *M. x giganteus* had higher nitrogen and water use efficiencies (Dohleman et al., 2009).

M. x giganteus has been shown to have low soil nitrogen requirements. Based on field studies from across Europe, the optimal nitrogen fertilizer application amount was found to be 60 kg ha^{-1} $year^{-1}$ (Lewandowski et al., 2000). However, some studies also observed that nitrogen fertilizer had no significant effect on biomass yield after the first year of growth (Himken et al*.,* 1997; Lewandowski et al., 2000). Most of the nutrients, including nitrogen, remobilize to the rhizome after senescence. However, between 46 and 85 kg ha^{-1} $year^{-1}$ of nitrogen remains in the aboveground biomass and does not make it back to the rhizome by mid- to late winter (i.e. the time of most harvests) (Cadoux et al., 2012). 60 kg ha^{-1} $year^{-1}$ is the approximate amount needed to replenish the nitrogen lost in the late winter harvest of the aboveground biomass and to maintain the productivity of the rhizome. Additionally, due to the large leaf area of

M. x giganteus, water interception values are quite high for the crop, at approximately 25% of rainfall (Finch and Riche, 2010). As an additional consequence of the large leaf area, the plant has higher transpiration rates, which correlates to a higher soil water usage by *M. x giganteus* relative to corn-soybean rotation and switchgrass (McIsaac et al., 2010).

It has been recommended that harvesting *M. x giganteus* be delayed until late winter. This allows more time for the remobilization of nutrients to the rhizome. Furthermore, the additional time is correlated with lower ash and moisture contents in the aboveground biomass (Lewandowski et al., 2003). An unfortunate consequence of delaying harvest is that the yield tends to decrease by 35% (Lewandowski et al., 2003). This is due to leaves and upper stems falling from the plants over time.

M. x giganteus contains a higher lignin and cellulose fraction per unit mass during the winter harvest than other genotypes of the plant genus (Hodgson et al., 2010). Higher lignin correlates to a higher heating value of the plant (which is congruous to energy content), particularly as it relates to thermo-chemical conversion to biofuel. The energy content of *M. x giganteus* has been found to be 4238.1cal/g (Collura et al., 2006). As of the year 2000, uses of *M. x giganteus* biomass have largely been confined to either 50% co-firing or 20% co-firing with coal in combustors in Europe (Lewandowski et al., 2000).

M. x giganteus has been shown to be a very hardy plant in terms of resisting cold weather by maintaining photosynthetic capacity by dint of its specialized gene expression pathways (Wang et al., 2008). Moreover, plants that had overwintered in the field showed better frost tolerance than plants of the same age that had not been in the field during winter (Plazek et al., 2011). Of the non-overwintered plants, those that had been cold acclimated were more frost tolerant than those that were not. Additionally, frost tolerance increases with every successive exposure to cold temperatures (below 12°C). Soil temperatures below -3.5°C have been seen to cause rhizome death in an artificial freeze experiment conducted in Germany (Lewandowski et al., 2000). Selectively breeding for higher frost tolerance may improve the ability of the rhizome to overwintering. Furthermore, a long first growing season allows for enough development of the rhizome for it to have a better chance of surviving the first winter.

In addition to *M. x giganteus* being a robust plant, it is readily adaptable to current agricultural methods, such as herbicide application. Weed control is essential for plant establishment, and herbicides are a common method of removing competing plants. Herbicides with broadleaf specific activity do not produce significant injury to *M. x giganteus* plants (Anderson et al.,2010). For the most part, herbicides that are currently used on corn can be used safely on *M. x giganteus*, especially at lower application rates.

Agriculturally Marginal Land

The 1 billion tons of agricultural biomass that will be needed each year to meet annual needs cannot be produced currently without agitating the processes of food production (Heaton et al., 2008). Nearly 1.366 billion tons of biomass could be produced annually by the year 2030. The use of perennial groups of plants could be produced in the amount of 377 million tons of biomass on only 24 million hectares of inactive and unused agricultural land. This correlates to only 13% of the agricultural land producing 38% of the necessary biomass (Heaton et al., 2008). This further exemplifies why being able to prove the use of marginal land for the growth of biofuels in an economic and sustainable fashion is so beneficial for the future of the bioenergy movement. The ability of *M. x giganteus* to grow on agriculturally marginal land would help prove this point if significant results can be measured.

Currently, there is a very large amount of agriculturally marginal land. This is land not suitable for use in the production of food, due to factors such as low nutrient levels and low water access. There are seven general classifications of land. The marginal land that is being used for this study is classified as Class 7 with "no capability of arable culture or permanent pasture" (Ministry of Agriculture, Food and Rural Affairs, 2009). The pedological descriptions of this site and the arable soil site are given in the Methodology section.

This land may be made useful by increasing water content through the addition of relatively inexpensive CLP. According to Abd El-Rehim et al., water-absorbing polymers increases soil water retention which can lead to better plant growth (2004). If this land can become productive and produce biofuels, then available land currently used for biofuel production can be diverted into producing food stock.

A few studies have attempted to test the effect of CLP on plants in poor soil with mixed results. A study in Germany tested the effect of CLP on *Pinus halepensis* subjected to drought, finding that applying the polymer to seedlings caused them to survive twice as long and grow up to three times larger than untreated plants

(Huttermann et al., 1999). Another study in Europe found that CLP did not increase the survivability of trees planted in dry, low-quality soil, but did increase their growth rates (Rowe et al., 2005). The same study suggested that adding nutrients such as nitrogen in addition to CLP could heighten the benefits of the polymer. A study done in the southeastern coastal plains of the United States tested CLP on sandy soils and found that their effect diminished with time and that CLP did not significantly improve the yields of maize (Busscher et al., 2009). A study specifically looked at the water holding capacity of CLP across time and subjected it to a variety of conditions. The researchers found that UV exposure and freeze/thaw cycles produced the greatest loss in water-holding capacity (Holliman et al., 2005). Furthermore, the water holding capacity decreased sharply within 18 months (Holliman et al., 2005).

Land currently used for agricultural production for food is decreasing as more usage of maize-based biofuels places significant strain on the availability of arable land. If this harsh land, with or without CLP, can produce significant lignocellulosic plant growth, then arable land can be used for creating food while marginal land can be used for producing biofuels.

Biofuel Conversion

Currently, the main types of biomass processing are gasification/pyrolysis and hydrolysis and enzymatic digestion. Neither has seen industry application as of yet, but they are upcoming methods for using lignocellulosic biomass as a novel source of liquid fuel.

Gasification and pyrolysis make use of the fact that plant material, when heated to certain temperatures under controlled conditions, will degrade into simpler organic compounds (Carroll and Somerville, 2009). Gasification produces a mixture of gases, called syngas, by heating plant material in the presence of a catalyst to high temperatures (900-1000ºC), which are then catalytically converted into hydrocarbons that are then refined into substitutes for conventional fuel (Carroll and Somerville, 2009).

Fast pyrolysis involves quickly heating the biomass to 350-600ºC or higher in the absence of oxygen (Melligan et al., 2011). The benefit of pyrolysis is that it produces a liquid fuel, called bio-oil, that is easier to transport than biomass or syngas (Melligan et al., 2011). Pyrolysis typically has liquid yields of 70-75% for wood and 55-65% for grasses based on the dry weight of biomass converted, though the yield can vary widely for different feedstocks (Hodgson et al., 2010). Hodgson et al. also found that the application of nitrogen fertilizer on *M. x giganteus* had a negative effect on feedstock quality and the resulting pyrolysis liquid (2010).

The main advantage of gasification processes is that relatively high yields of syngas can be obtained (Digman et al., 2009). Gasification is one of the most efficient methods of energy extraction, and it has the benefit of being insensitive to the composition of the starting material as well, making many kinds of biomass acceptable for use (Digman et al., 2009). Syngas is also readily converted into gasoline and diesel fuel (Carroll and Somerville, 2009). However, this method is not without problems – gasification reactor design is costly and complicated. Byproducts of the gasification reaction, which include sulfur, mineral ash, and tars, do accumulate rapidly and constant maintenance of the reactor is necessary in order to keep it in working condition, which increases costs (Digman et al., 2009). Pyrolysis functions similarly to gasification in terms of efficiency – however, it yields a mixture of complex organic liquids similar to crude petroleum. This is very difficult to process, but the raw energy content of this material is high (Digman et al., 2009). Additionally, if the water content of the liquid is high, it limits the usefulness of the bio-oil as a fuel (Melligan et al., 2011).

Hydrolysis and enzymatic digestion use an extensive pre-treatment process and synthetic catalysts in order to process biomass. Biomass is ground into small particles and then soaked in moderate temperature dilute acid, which causes much of the normally sequestered sugars (such as xylans) to become soluble and more of the plant material to become accessible to enzymatic treatment (Digman et al., 2009). Enzymatic hydrolysis then breaks most of the polysaccharide components of the plant into simpler free sugars, which are then easily processed into fuel (Digman et al., 2009). This is not as efficient as gasification but does have the benefit of being a relatively low-maintenance process.

Experimental conversion of *M. x giganteus* into a usable liquid fuel is beyond the scope of this study. However, as the conversion technologies progress and become more cost effective, the possibility of widely using cellulose to create biofuels becomes more feasible. Furthermore, these technologies are evolving and being optimized independent of agricultural studies involving energy crops.

Economic Factors

Several regions of the world hold the potential to supply energy crops because of surplus arable land. These regions include North America, Europe, Oceania and Latin America. However, this supply potential is limited by the demand for food, both for human and animal consumption. Because of population growth and an increase in demand for lumber in developing areas, 24% of the global mature forest area will be converted to arable farmland from 1990 to 2100. In certain developing regions in Asia and Africa, the mature forest will disappear altogether by 2100 (Yamamoto et al., 2001). The depletion of forest area for the sake of farming will work against the goal of alternative fuel development. For this reason, among others, it is important to make use of currently existing marginal land for biofuel production.

The major economic aspects of commercially producing biofuels like *M. x giganteus* include the logistical decisions made by producers regarding elements of the supply chain. Transportation and storage present examples of some of these supply chain elements. The cheapest method of transporting a biofuel like cotton-stalk, for example, requires that the farmers are included in the supply chain's logistical model. As transport vehicles' capacities rise, different farmers and producers are more likely to achieve economies of scale within the cotton-stalk industry. This model can be applied to other biofuels besides cotton-stalk as well (Tatsiopoulos et al., 2003).

Another element of the supply chain that is important to analyze for biofuel production is storage. Storage is often determined by seasonal availability. The lowest cost storage methods generally provide the most efficiency to producers. However, these methods may present health, safety and technological risks that should be considered (Rentizelas et al., 2009).

Because *M. x giganteus* currently lends itself best to use as a solid fuel, the costs of pelletization are important in economic analysis. Pelletization operations include drying, densifying, screening and warehousing, among other processes. Raw material presents the largest cost of pelletization. Other major costs include personnel costs, drying costs and pelleting mill costs. For a baseline plant of 6 t per hectare, the pelletization costs were $51 per ton of pellets (Mani et al., 2006).

Economic Implications

A top down approach was use to evaluate *M. x giganteus'* potential commercial applications. This began with an analysis of the market for energy in the United States. Specifically, the market for electric power as *M. x giganteus* in the form this study evaluated would primarily be used to generate electricity. Special attention was paid to the retail electricity market in the state of Maryland as well as the use of renewable energy sources, including biofuels such as *M. x giganteus*, in these regions.

U.S. Energy Consumption

The following values were developed from data found in U.S. Energy Information Administration Annual Energy Review (Adler et al., 2011).

Over the past 60 years electric power energy consumption in the United States has increased by over 775.9% at a compound annual growth rate of 3.7%. Population and per capita income are major drivers of electric power consumption and as these factors grow the increase in energy usage is expected to continue.

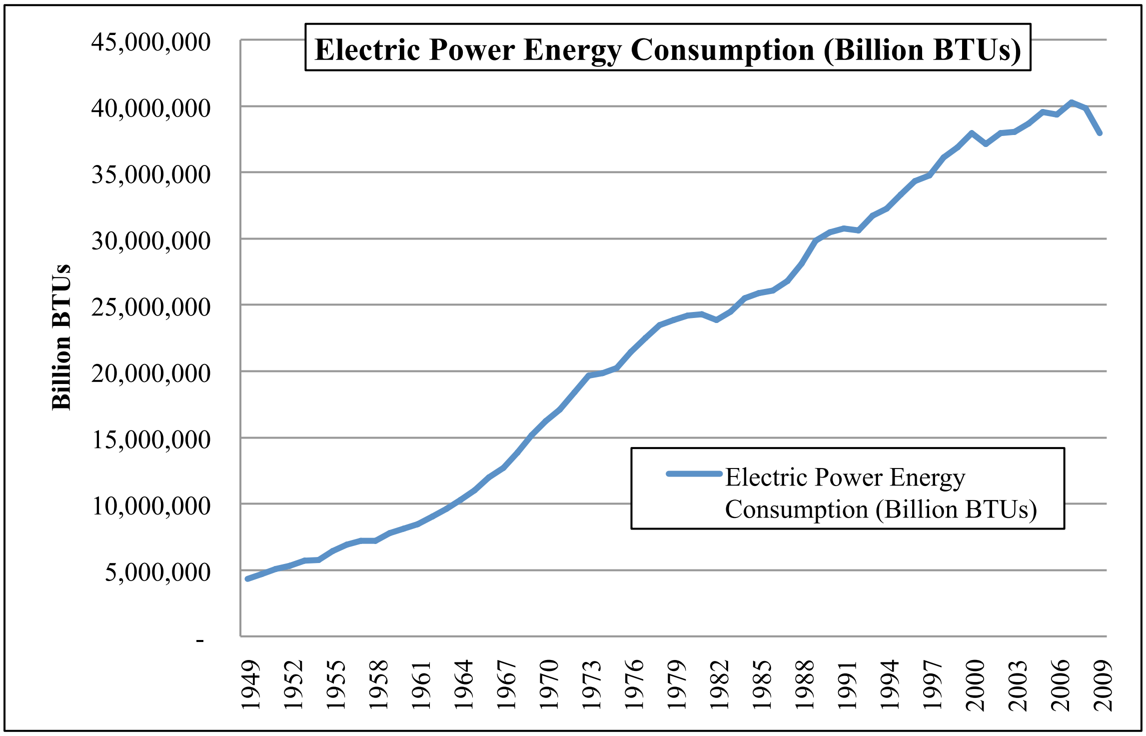


Figure 3. Electric Power Energy Consumption.

This trend is coupled with decreasing reserves of traditional energy sources. Currently, electricity is produced primarily by coal, natural gas, and nuclear energy. Natural gas as a percentage of total energy consumption is growing has grown at a compound annual growth rate of 0.5%, the second largest of any energy class over the 6 years from 2005 to 2010. Renewable energy sources however, are the fastest growing source of energy in the U.S. with a compound annual growth rate of 5.6% for liquid biofuels and 1.1% for other renewables over the same time period.

Table 1. Historical U.S. Energy Consumption by Source.

Historical U.S. Energy Consumption by Source (% Total Consumption)

Energy Source	2005	2006	2007	2008	2009	2010	2011	Change	CAGR
Oil and other liquids	40.3%	40.1%	39.3%	37.6%	37.5%	36.7%	36.0%	*(10.6)%*	*(0.5)%*
Coal	22.8%	22.6%	22.5%	22.6%	20.8%	21.3%	21.0%	*(7.8)%*	*(0.3)%*
Nuclear	8.1%	8.3%	8.4%	8.5%	8.9%	8.6%	8.4%	*3.0%*	*0.1%*
Natural gas	22.5%	22.3%	23.4%	24.0%	24.7%	25.2%	25.6%	*13.9%*	*0.5%*
Liquid biofuels	0.3%	0.5%	0.6%	0.8%	1.0%	1.1%	1.3%	*272.1%*	*5.6%*
Renewables (excluding liquid biofuels)	5.9%	6.2%	5.9%	6.4%	7.1%	7.1%	7.7%	*30.2%*	*1.1%*

Energy consumption by type is expected to shift away from existing sources, like coal and petroleum, and towards renewables. These shifts will create opportunities for new commercial energy production enterprises. Public policy is pushing for faster integration of renewable energy sources, such as solar, wind, and biofuels, into the energy production mix of the United States. This will result in a sizable increase in the use of renewable energy sources over the coming 20 years. As Table 16 suggests, liquid biofuels can expect to see a 191.2% increase in usage and other renewables a 41.7% increase in usage by 2035. Indeed by that time renewable energies are expected to account for as much as 15% of the primary energy consumption in the United States.

Table 2. Projected U.S. Energy Consumption by Source.

Projected U.S. Energy Consumption by Source (% Total Consumption)

Energy Source	**2011**	**2012**	**2015**	**2020**	**2025**	**2030**	**2035**	**Change**	**CAGR**
Oil and other liquids	36.0%	36.1%	36.4%	35.1%	33.9%	32.5%	31.6%	*(12.3)%*	*(0.5)%*
Coal	21.0%	20.0%	18.5%	19.3%	20.1%	20.0%	20.0%	*(4.7)%*	*(0.2)%*
Nuclear	8.4%	8.7%	8.9%	9.2%	9.3%	9.1%	8.7%	*3.5%*	*0.1%*
Natural gas	25.6%	26.6%	26.7%	26.0%	25.1%	25.2%	25.2%	*(1.9)%*	*(0.1)%*
Liquid biofuels	1.3%	1.3%	1.5%	1.8%	2.2%	3.0%	3.7%	*191.2%*	*4.6%*
Renewables (excluding liquid biofuels)	7.7%	7.3%	8.0%	8.6%	9.4%	10.1%	10.9%	*41.7%*	*1.5%*

Given the trajectory of renewable energy sources – especially that of biofuels – it is likely that there will be a significant market for biofuel production.

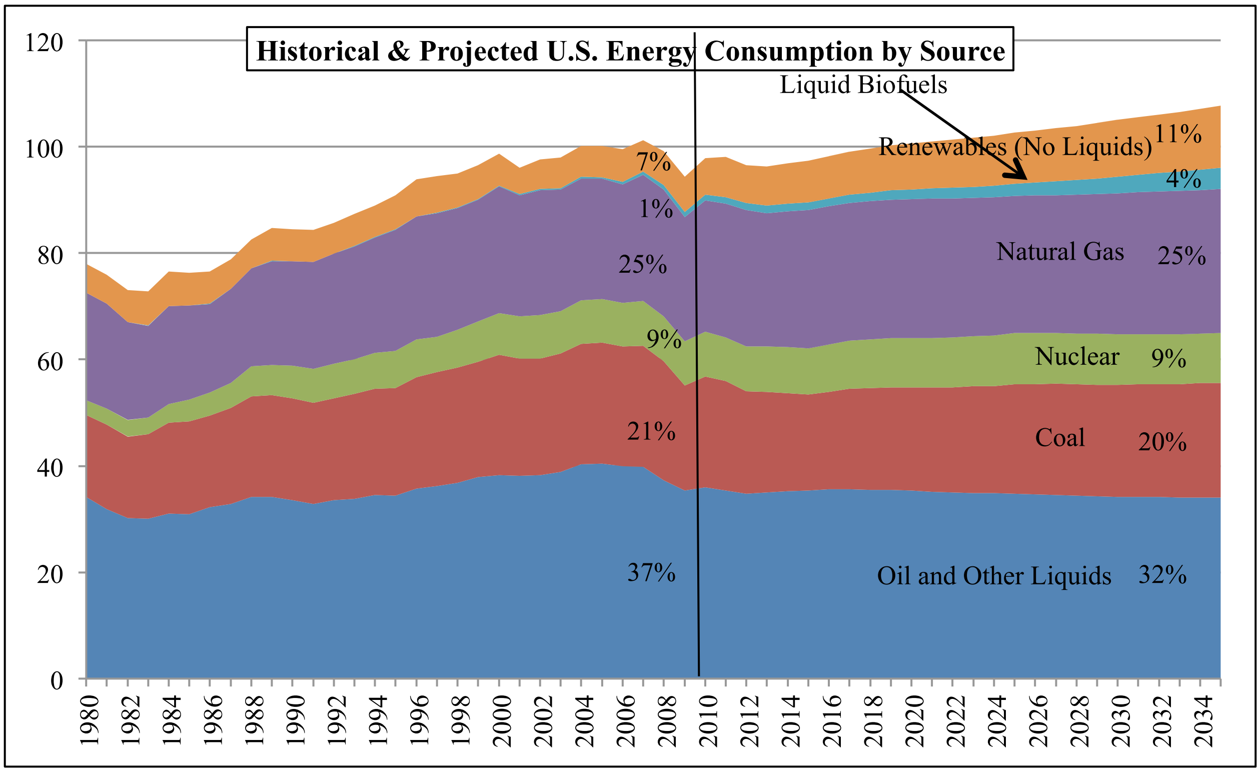


Figure 4. Historical & Projected U.S. Energy Consumption by source.

U.S. Energy Production (Excluding Renewable Energy)

To fully understand *M. x giganteus*' potential as a commercial enterprise, it is important to see how the demand energy is produced.

Coal

U.S. production of coal has increased over the past 60 years, and despite periods of significant volatility, real prices have remained stable. With that said, coal production by type and quality has changed significantly. Coal quality is determined according to response to increasing heat and pressure as well as carbon content, and lower quality coal has a lower energy content as measured by million BTU /ton. This means that as the quality of coal in use decreases, the amount required to produce the same amount of energy increases. Today the coal used in the U.S. is predominantly bituminous coal, however an increasing percentage is made up of lower quality lignite and sub-bituminous coal and almost none is high quality anthracite coal.

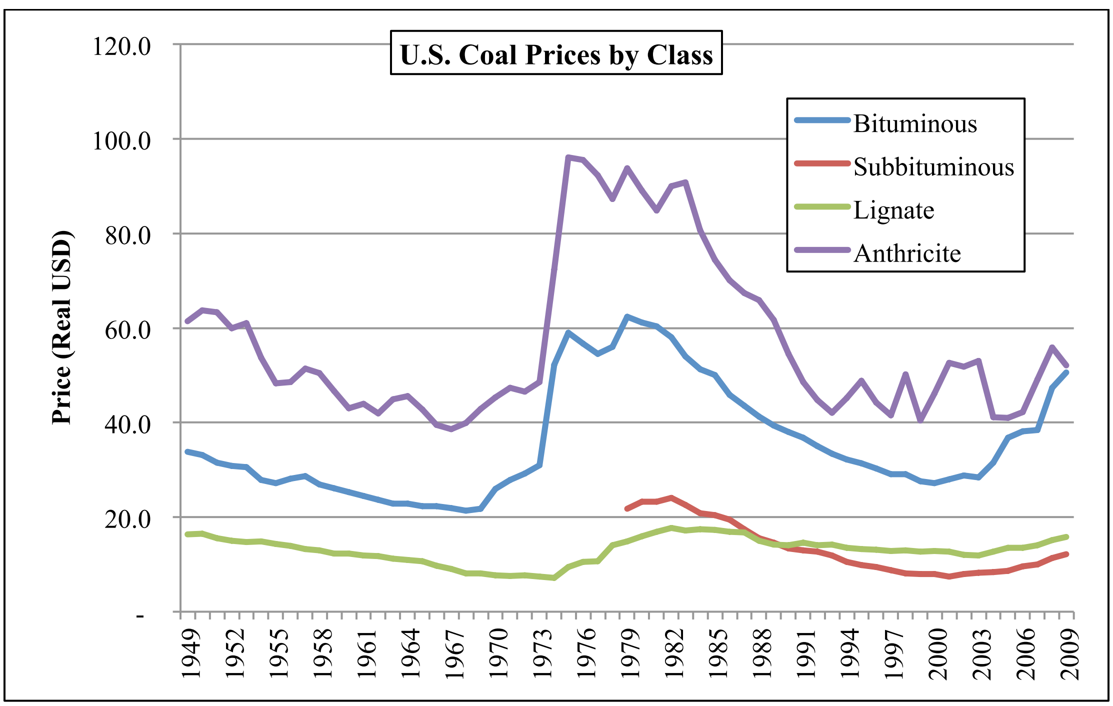


Figure 5. U.S. Coal Prices by Class.

Anthracite coal has seen a 98% reduction in U.S. production since 1949, compared to sub-bituminous coal use, which grew over 3,000% over the same time period. Therefore notwithstanding price stability overall expense associated with coal use has increased as a result of reduced quality. This trend is expected to continue as the U.S. further depletes higher quality coal reserves.

Table 3. U.S. Coal Production by Type.

U.S. Coal Production by Type (Summary Years)

Year	Bituminous	Subbituminous	Lignite	Anthracite
1949	91.1%	0.0%	0.0%	8.9%
1969	95.8%	1.5%	0.9%	1.8%
2000	53.5%	38.1%	8.0%	0.4%
2009	46.9%	46.2%	6.7%	0.2%
Change	*(48.5)%*	*3,069.0%*	*668.1%*	*(98.0)%*
CAGR	*(1.1)%*	*5.9%*	*3.5%*	*(6.3)%*

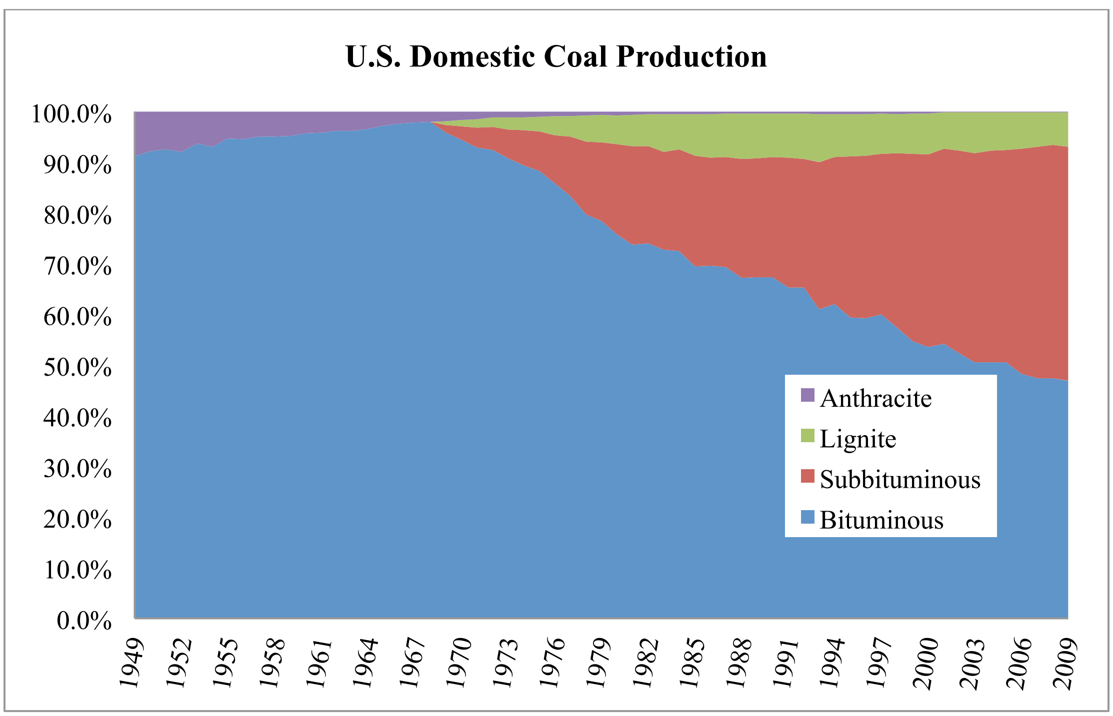


Figure 6. U.S. Domestic coal production

Natural Gas

Natural gas is the second fastest growing energy class in the United States with an estimated compound annual growth rate of 0.5% over the past six years from 2005 to 2010. Advances in technology have led to significant increases available natural gas reserves and this has helped to fuel its increasing usage.

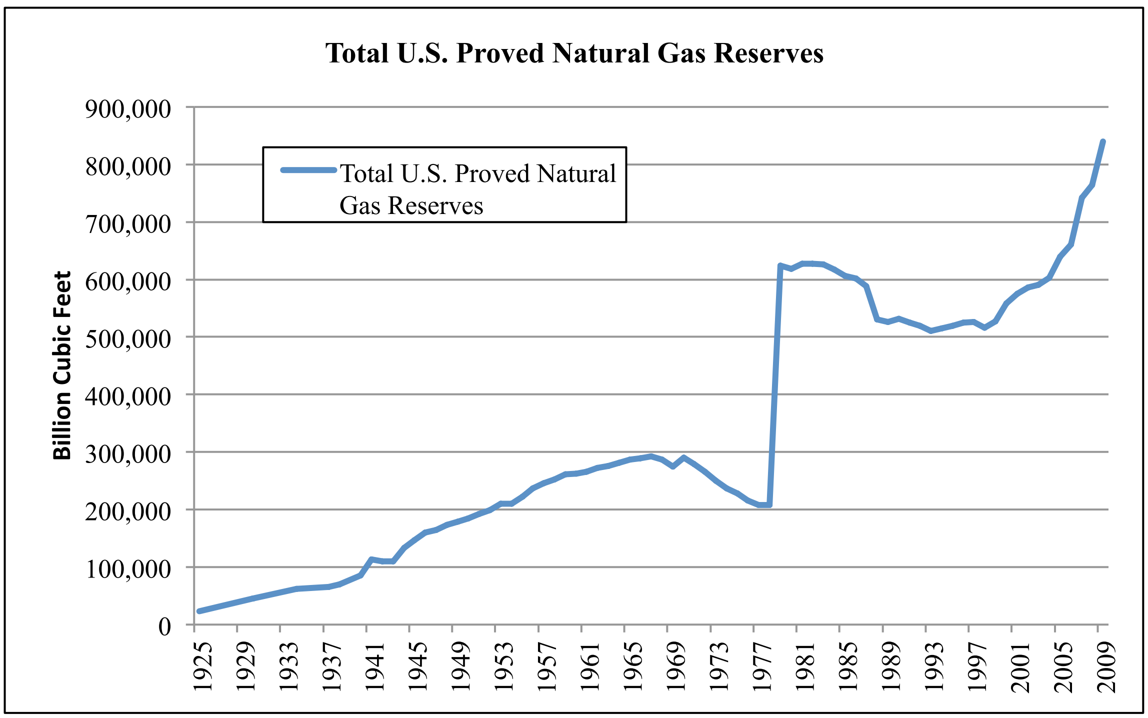


Figure 7. Total U.S. proved natural gas reserves.

Natural gas is widely traded in commodity markets and, as a result, sometimes experiences significant price volatility. However, as part of the large market for natural gas, a vibrant futures market exists. This provides a means of projecting price in future periods based on current futures contract prices. Figure 8 displays U.S. natural gas prices for use in electricity production from January 2002 to December 2011. **Figure 9** shows futures prices for natural gas through 2020.

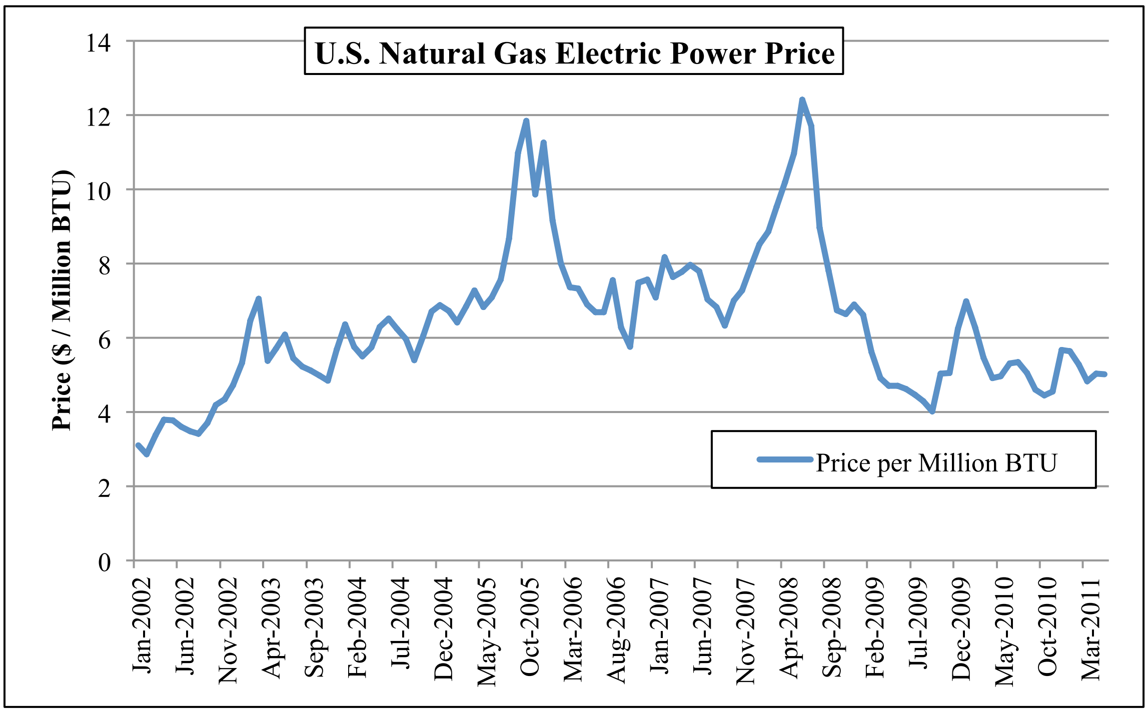


Figure 8. U.S. Natural gas electric power price

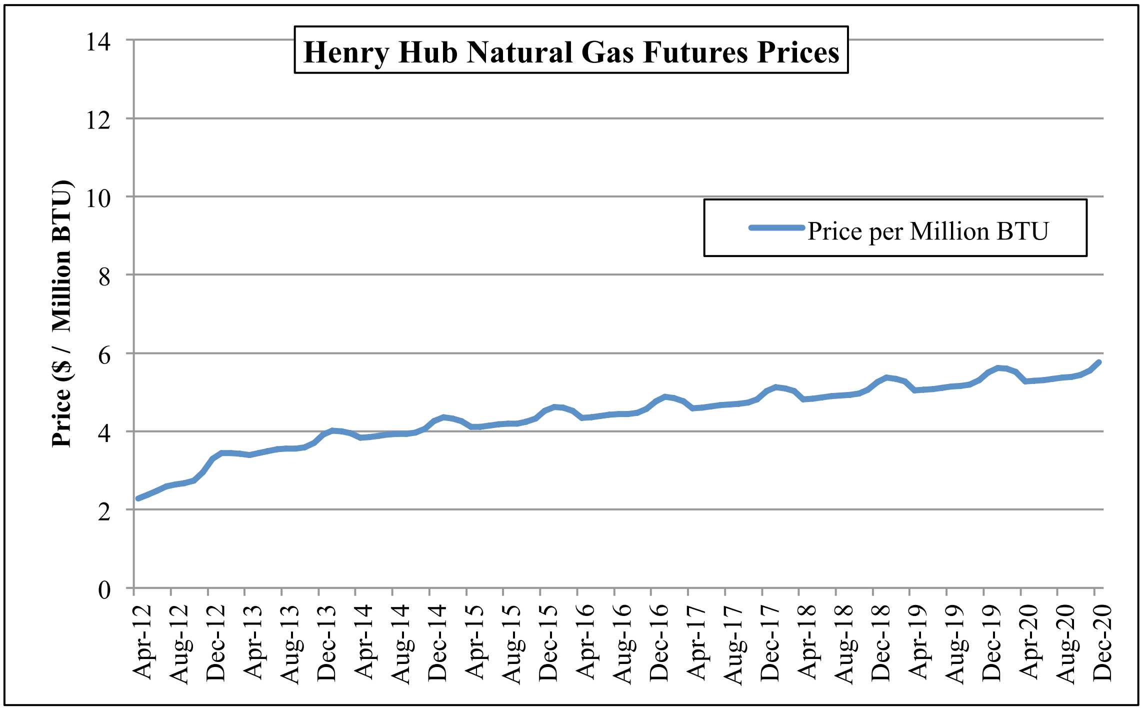


Figure 9. Henry Hub natural gas futures prices.

Notwithstanding volatility throughout the period, natural gas prices are roughly where they were in 2002. Short-term futures prices are significantly lower than current natural gas prices and this suggests a decrease in prices moving forward. The upward trend in Figure 9 is the result of premiums paid by purchasers of longer term futures contracts to lock in their price now. Futures prices are quoted in terms of cost including physical delivery to a particular location, referred to as a pricing point. Frequently that is the Henry Hub located in Louisiana. Nevertheless, the futures prices in Figure 9 remain well below existing natural gas prices.

Due to the increase in reserves, advances in technology, and widespread support, low prices will likely persist and, as a result, natural gas is expected to play a large role in U.S. energy consumption going forward.

Nuclear

Nuclear energy is expected to remain a relatively constant portion of U.S. energy production as a result of the high fixed cost, regulatory hurdles, and long construction time associated with establishing a nuclear power plant.

Petroleum

Petroleum is an important source of energy production for the U.S. and will remain a sizable portion of U.S. energy production for the foreseeable future. With that said, increased regulatory burden and decreasing reserves will continue to put upward pressure on the expenses of upstream, midstream, and downstream oil and gas production companies. This will be reflected in higher prices for the consumer. Moreover, the U.S. imports a significant amount of petroleum products and as global oil production moves more towards offshore and unconventional sources, price increases will be more dramatic.

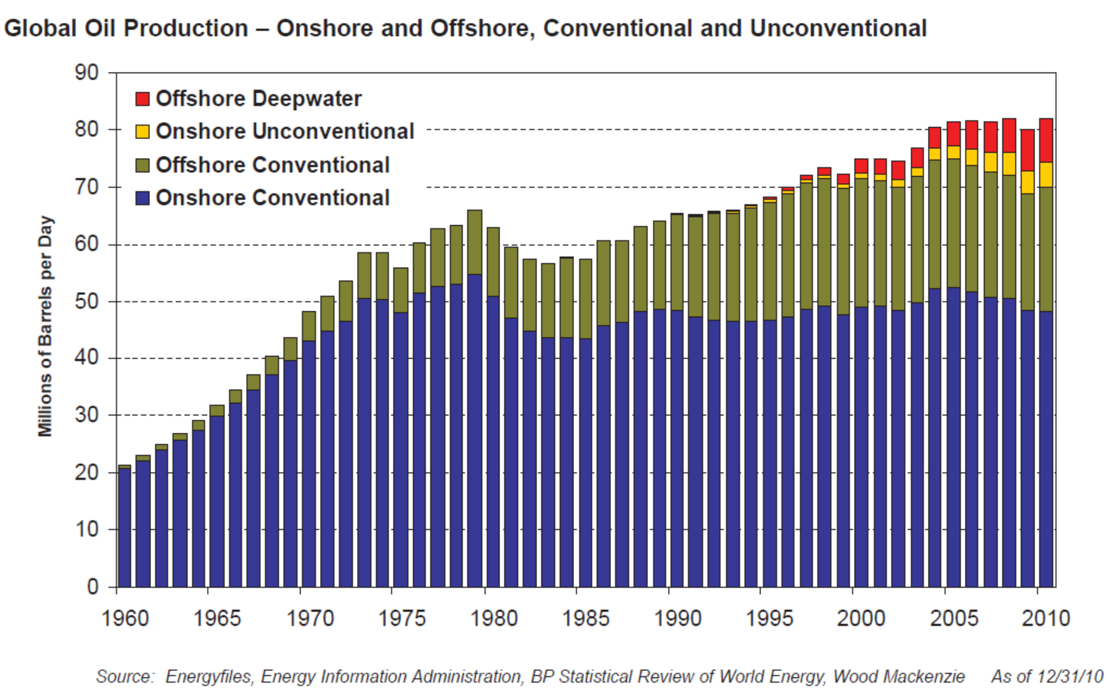


Figure 10. Global oil production

Energy In Maryland

Maryland has limited energy resources apart from the potential for wind power on the Chesapeake Bay and minor coal reserves in the Appalachian Mountains. As a result Maryland relies on energy source deliveries from other areas.

Table 4. Maryland state energy consumption by type.

Maryland State Energy Consumption By Type

Energy Source	**2006**	**2007**	**2008**	**2009**	**2010**	**Change**	**CAGR**
Coal	60.1%	59.2%	57.5%	55.2%	54.3%	*(9.6)%*	*(2.0)%*
Petroleum	1.2%	2.0%	0.9%	0.8%	0.7%	*(37.8)%*	*(9.1)%*
Natural Gas	3.6%	4.5%	3.9%	4.0%	6.6%	*83.7%*	*12.9%*
Other Gases	0.7%	0.8%	0.7%	0.6%	0.5%	*(27.3)%*	*(6.2)%*
Nuclear	28.2%	28.6%	31.0%	33.2%	32.1%	*13.6%*	*2.6%*
Renewables	5.6%	4.5%	5.5%	5.6%	5.1%	*(7.8)%*	*(1.6)%*
Pumped Storage	0.0%	0.0%	0.0%	0.0%	0.0%	*0.0%*	*0.0%*
Other	0.6%	0.6%	0.6%	0.6%	0.6%	*(0.6)%*	*(0.1)%*

Over 50% of the electric power in Maryland is produced using coal, which comes primarily from Pennsylvania and West Virginia. Coal transportation costs have recently increased 54.1% and 37.5% from both states respectively. Another third of the electric power consumed in Maryland is provided by its only nuclear power plant at Calvert Cliffs.

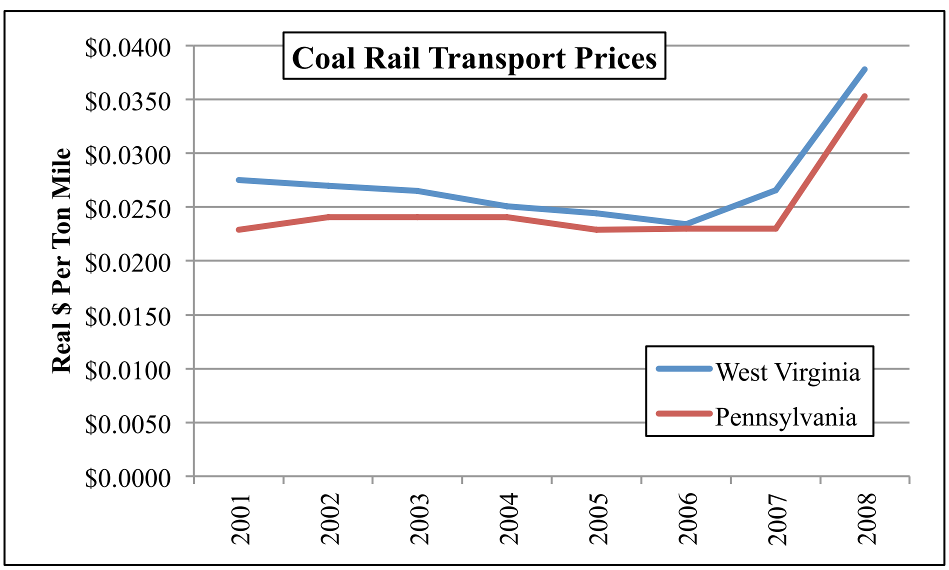


Figure 11. Coal rail transport prices.

Trends suggest that as a percentage of total energy consumed, coal will decrease and be replaced increasingly by natural gas and nuclear power. Interestingly, Maryland lies behind the curve in adoption of renewable energy sources having seen a 7.8% decrease in renewables usage from 2006 through 2010.

Table 5. Maryland state renewable energy consumption by type.

Maryland State Renewable Energy Consumption By Type

Energy Source	2006	2007	2008	2009	2010	Change	CAGR
Geothermal	0.0%	0.0%	0.0%	0.0%	0.0%	*N/A*	*N/A*
Hydro Conventional	77.1%	73.3%	76.3%	77.4%	74.4%	*(3.5)%*	*(0.7)%*
Solar	0.0%	0.0%	0.0%	0.0%	0.02%	*N/A*	*N/A*
Wind	0.0%	0.0%	0.0%	0.0%	0.04%	*N/A*	*N/A*
Wood / Wood Waste	8.0%	9.0%	7.7%	7.2%	7.4%	*(7.8)%*	*(1.6)%*
MSW Biogenic / Landfill Gas	14.9%	17.7%	16.0%	15.4%	18.2%	*21.5%*	*4.0%*
Other Biomass	0.0%	0.0%	0.0%	0.0%	0.02%	*N/A*	*N/A*

It is expected that this trend will reverse in light of a greater push for renewable energy sources at the federal level and increasing costs of other sources of energy, most notably coal. Indeed, given Maryland's current reliance on coal firing plants for energy production, there could be a significant opportunity to leverage the existing infrastructure to burn dry biomass pellets, such as *M. x giganteus*.

CHAPTER 3: METHODOLOGY

Methodology

Research Design – Field Aspect

Woodstock Site Description

In 1928, the Affeldt family of Woodstock, Maryland acquired a 21.45-hectare (53-acre) farm, located 0.09 miles from the western border of Ellicott City (Google Earth, Inc.) and immediately east of the Howard County Conservancy. The Woodstock plot was a personal garden until twenty years ago, and has lain fallow since. The area used for this study, about 0.162 hectare (0.4 acre), was used as a private garden, growing corn, tomatoes, string beans, white potatoes, sweet potatoes, peas, watermelon, cantaloupe, asparagus, strawberries, and okra on rotation for 35 years. No fertilizer was ever applied. From 1995 to 2009, the plot laid fallow with only various small weedy grasses growing on it. On June 2, 2009, the plot was cleared of all weeds and was thoroughly tilled. The soil is composed primarily of good dirt, clay, and moderately-sized rock.

The northern, upper part of the plot has an 8-15% slope. However, the plants were grown on the southern, lower part of the plot, which is relatively flat. There are lines of trees to the north, east, and south sides, and a home to the west. Sparse trees surround the plot, usually occurring in a single-file manner. For example, a row of 75-foot tall pine trees lies 50 feet west of the plot. The plot receives full sun for most of the day; however, the 75-foot tall pine trees shade the plot near sunset. According to the USDA Natural Resources Conservation Service Web Soil Survey, the soil in the plot is Glenville silt loam, containing silt loam soil to a depth of 30 inches.

Brandywine Site Description

The ERCO Beneficial Reuse Tree Farm site is a privately owned 49.4 ha. (122 acres) sand and gravel mine spoil in Prince George's County, MD. The site is in the coastal plains physiographic region, approximately 32 kilometers (20 miles) east of the escarpment region that identifies the piedmont physiographic region, and it is approximately three miles north of Waldorf, MD (Figure 3).

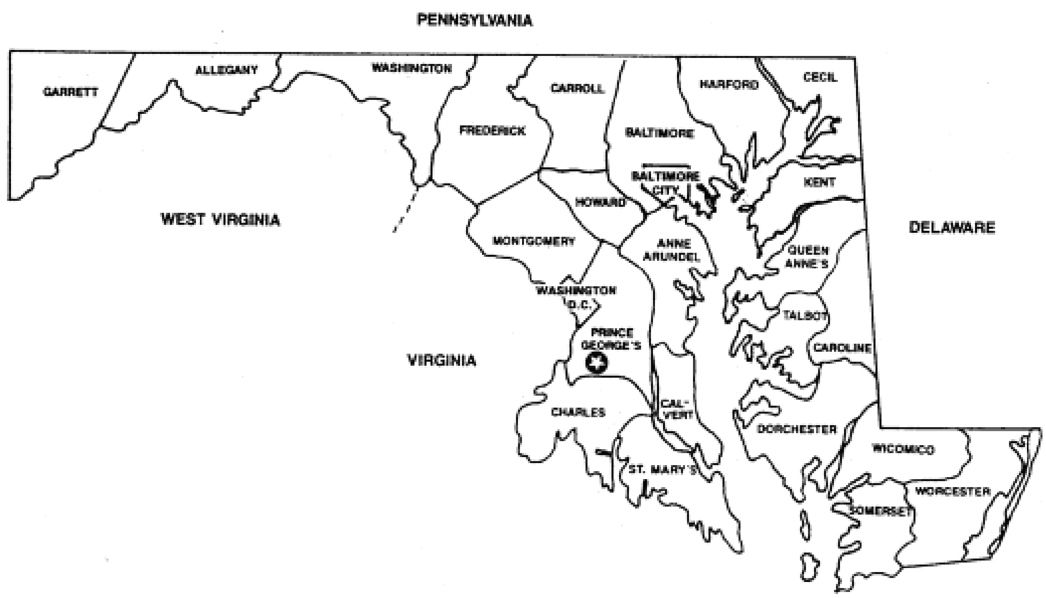


Figure 12. ERCO study site, located in Prince George's County, MD within the Washington, D.C. metro area.

The site consists of a plateau with steep banks that fall away to incised streams. The edges of the plateau are bermed and runoff is routed to one of seven detention ponds. All steep banks are covered with permanent forest cover. The plateau has an upper area (two sections) near the entrance on a 0-2% slope. The remaining seven sections have an elevation drop of between 1.5 and 3 m (5-10 ft.), followed by a level section (0-2% slope) to the edge of the plateau.

The research site is an existing portion of the plateau that was part of the office area. The research plots are on a bare parking area that has been compacted by the movement of heavy equipment. The Brandywine plot is level, and composed primarily of clay, rock, and poor dirt, though it is slightly sandier to the south portion.

There are conventional soils on the steep side slopes that were not disturbed by sand and gravel mining, but there are no soils, as is the normal convention, on the plateau surface. In 1983, following cessation of the sand and gravel mining activity, the soil consisted of a clay layer with occasional remnants of sand and gravel and some gullies that were filled with soil during the re-grading process in 1983. The clay layer was 1.5 m to 21.3 m (5' – 70') or more thick. The following description of soils and geology at the ERCO site was derived from Wilson and Fleck (1990) and, to a lesser extent, Tompkins (1983) and begins with the deeper deposit first and concludes with the surface deposit that was removed in the mining operations (Wilson and Fleck, 1990; Tompkins, 1983).

The lower formation is the Marlboro Clay (late Paleocene), a leaky confining unit of dense, reddish silty clay between 4.6 m and 7.2 m (15' – 30') in thickness. The lower Eocene Nanjemoy formation overlies the Marlboro Clay, and predominantly consists of beds of dark green, fine to medium, glauconite-bearing sands in the upper part of the formation and is a water-supply aquifer in many parts of southern Maryland. The thickness of the Nanjemoy at Waldorf ranges from 27.4 m to 38.1 m (90' – 125').

Overlying the Nanjemoy is the lower Miocene Calvert Formation. The Calvert is a light to medium, olive gray to olive green, micaceous, clayey silt that acts as a hydrologic confining unit. The thickness of the Calvert in the Waldorf area is 27.4 m to 30.5 m (90' – 100'). The formation is the basal unit of the Chesapeake Group and it represents deposition in a marine shelf environment.

The Calvert is overlain by the Pliocene Upland Deposits. The Upland Deposits consist of orange-tan, silty, fine to very course sands and gravels, and yellowish to orange, silty clays. The Upland Deposits range from 6.1 m to 15.2 m (20' – 50') thick and crop out throughout the Waldorf area. These materials were removed in the sand and gravel mining process. Hence, the ERCO site has very slight remnants of the Pliocene Upland Deposits over the Calvert clayey silt, over the Nanjemoy.

Field Setup

Four hundred forty *M. x giganteus* plants were purchased from Kurt Bluemel in Baldwin, MD, on May 20, 2009. They were transplanted and stored in Scott's potting soil in wide, flat bins containing 80-100 plants each, until planted at either the Woodstock or the Brandywine plot. The polymer, CLP, was purchased from Water-Keep.

The *M. x giganteus* was planted in rows of ten plants each, eighteen rows total. Each row of ten plants runs north to south, and the eighteen rows are spaced east-to-west. Crimp fishing weights were attached to a piece of twine at three-foot intervals. The strings were laid on the plot in straight lines, north-south, and were spray-painted at each crimp weight. Each dot of spray paint represented the location where a plant would be placed.

At Woodstock, plants were planted using two shovels, one hand trowel, and a rotary tiller to mix polymer. Every other plant received 12.25g of polymer mixed into the soil by shovel or rotary tiller. Plants were deposited in 3-4 inch holes deep enough to cover the rhizome but not the plant stalk, and then watered generously. On June 9, 2009, 121 plants were planted, and the remaining 60 plants were planted on June 14, 2009.

At Brandywine, plants were planted using an auger, two shovels on the first day, four shovels on the second day, and one hand shovel. The ground was soaked with water in order to soften the earth to allow digging with auger. Every other plant received 12.25g of polymer mixed into the soil by hand. Plants were deposited into holes deep enough to cover the rhizome but not plant stalk, and then watered generously. On June 27, 2009, 110 plants were planted, and the remaining 54 plants were planted on August 16th.

On August 30, 2009 and September 7, 2009, the Woodstock location was visited in order to remove weeds. This was only conducted in the first year of planting – during later years the *M. x giganteus* was tall and hardy enough to generally ignore the effects of weeds.

Because of concerns identified by our experts over statistical validity, it was necessary to determine if growth was independent of adjacent plants in the original plant layout. Therefore, small plots were planted to compare growth with and without polymer.

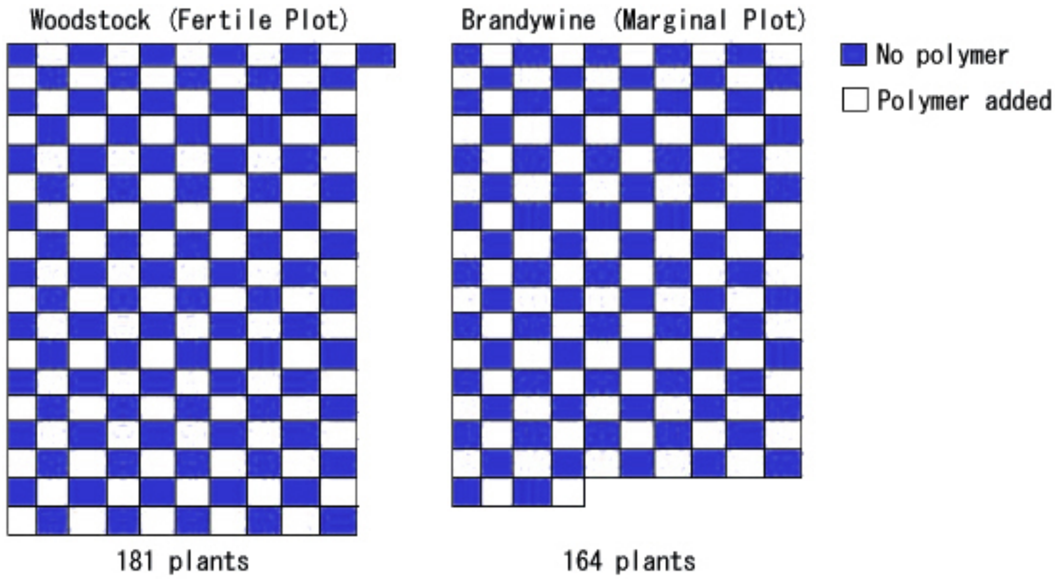


Figure 13. Checkerboard layout of both the Woodstock and Brandywine plots.

On May 20, 2010, six small plots, each consisting of 16 plants arranged in a 4 by 4 pattern, were planted at Brandywine. The plants were again three feet apart. Each small plot was six feet away from any other small plot and at least nine feet away from the large plot. Three small plots contained polymer for all of the plants and three contained no polymer. The previous procedure for polymer addition was followed. The assignment of polymer treatment was random. The same procedure was followed at Woodstock on June 13 and 19, 2010 for the six small plots at this site.

Woodstock plants are watered by hand, using buckets of water carried from a neighboring home during the establishment year, and Brandywine plants are watered by a sprinkler system. The frequency of watering is directed by Dr. Gary Felton.

Each plot's harvested biomass was separated on the basis of polymer presence. The edge plants were discarded. Plants from two consecutive rows were combined to make one sample, which will also be known as a bag from this point onward. For the small plots, the edge plants were also discarded. The remaining plants in each small plot were bagged as one sample for a total of six samples per site. Each sample was dried for 2 weeks at 35 °C in a drying chamber at the University of Maryland.

Grinding was performed using an electric belt-driven Wiley® Mill. The grinder consisted of a rotating drum with four blades and a 1mm sieve screen. The main grinding compartment has an entry funnel and sliding door to control the rate of entry of samples into the main grinding barrel. Samples were taken from labeled bags and cut into one-inch to two-inch pieces to facilitate entering the funnel of the machine. Plain scissors were used to cut these pieces to size over a tarp to reduce to the loss of a part of each given sample. The tarp was cleaned using pressurized air between samples. The main door of the grinding barrel allowed for access to sample pieces that did not pass through the screen. The collection chute, at the base of the grinding barrel and under the screen, allowed for collection of finer pieces of the ground sample. Samples were collected in bags at the base of the chute. (Note: The minimum size of samples for calorimetric analysis was 10g. Some samples were combined to meet this requirement and larger pieces left in the grinding barrel were collected to achieve this minimum mass.)

After each composite sample was ground, the grinder was cleared of all debris using pressurized air in order to prevent cross-contamination of samples with previous samples. The duration of the grinding process was 11 hours and 45 minutes over six days for the first harvest material. For the grinding of the material from the second harvest, as second belt-grinder was used. This allowed the grinding to be completed within 8 hours.

Differences in soil quality were determined by differences in the presence of certain nutrients. Total phosphorous content of soil was determined by a Mehlich 1 extraction (Knudsen and Beegle, 1996) followed by an inductively coupled plasma (ICP) measurement. Soil calcium, magnesium, and potassium contents were determined by a Mehlich 3 extraction (Knudsen and Beegle, 1996) followed by an inductively coupled plasma (ICP) measurement. Soil texture was determined via the hydrometer method (Gee and Bauder, 1986), and soil pH was measured potentiometrically in a slurry system using an electronic pH meter (McLean, 1982). These procedures were conducted at facilities at the University of Delaware Soils Lab and documented in NEC-1012, 2011.

Research Design – Laboratory Studies

Calorimetric Analysis

The Parr 1261 bomb calorimeter was used to determine the total energy content of the *M. x giganteus*. Benzoic acid was used to standardize the calorimeter and the Parr 1108 pressure bomb. The bomb was pressurized to 400 psi with oxygen for each run; the bombs were not purged. Each run used 10 cm (23 cal) of Parr ignition wire to start the combustion reaction. The calories contained in the unburned wire after each run were recorded. However, three calories of unburned wire was set as the default for the calorimeter to take into account when computing the energy content of each run. It was assumed that any deviation from three calories did not cause a significant change in the final energy content of that run.

Initially, 0.8-0.9 g of loose ground *M. x giganteus* was burned per run. However, the rapid combustion of the loose material produced a swift increase in pressure inside the bomb. The pressure rise caused the O-ring, which created the seal between the bomb head and the bomb cylinder, to be pushed back from the walls of the bomb cylinder. This allowed hot gas to reach under the O-ring and partially burn it, causing the O-ring to become progressively more flat on its inner surface. Furthermore, splatter from the reaction was seen on the underside of the bomb head, which indicated that the reaction was progressing too rapidly. After six to eight runs of this, the O-ring was no longer able to hold its seal and it had to be replaced. Overall, this problem resulted in incorrect energy content values; the reported values were the combination of the combustion energy from the *M. x giganteus* and that from the O-ring.

To obtain more accurate energy content values, the ground *M. x giganteus* was pelletized using a Parr Instruments Pellet Press. Pelletizing the *M. x giganteus* slowed the combustion reaction and, thus, reduced the rapid increase in pressure, which prevented the O-ring from burning. Additionally, no splatter was observed on the underside of the bomb head. Pellets were limited to 0.56-0.65 g due to the size of the press. In every run, complete combustion was observed and O-ring damage no longer occurred.

For each polymer treatment at each plot, six bags were chosen at random for analysis. The exception to this was with the Brandywine polymer plants for the 2011 harvest in which there were only five bags total. Three trials were run for each bag. The plants from all small plots for all harvest years were not analyzed for energy content. The biomass was not ground as finely as the plants from the large plots due to the low biomass yields from the small plots. The differences in plant particle size could result in different and non-comparable calorimetry values. Therefore, the biomass from the small plots was not analyzed via calorimetry. Furthermore, the purpose of these plots was only to verify plant independence in the larger plots.

For the 2012 harvest, only three bags for each polymer treatment at Brandywine were analyzed. Analyses were not performed on the Woodstock harvest because the energy contents from the previous harvests were consistent with each other. Furthermore, the 2012 harvests from all small plots were not analyzed for the same reasons as previously stated.

Tempe Cell Analysis

Soil water is retained by the capillary pressure that results from the geometry of the individual soil particles. As roots exert a suction on the soil water, more water is removed from the soil and the capillary pressure acting on the soil water increases. The relationship between the capillary pressure and the volume of water retained in the soil is called the soil water retention curve.

The addition of polymer to the soil should shift the soil water retention curve. By measuring this curve for soil samples with and without polymer, the change should be at least qualitatively apparent and possibly could be quantified.

Tempe Cell analysis was attempted for soil from Woodstock and Brandywine, with and without the polymer. Unfortunately, severe mechanical problems were encountered and data were unable to be collected.

Data Analysis

A factorial 2x2 ANOVA test was used to analyze the resulting biomass data. The two treatments administered in the study, soil quality and the presence of CLP, were be crossed with each other to determine if they made significant differences in mean biomass yield. The test can statistically compare the variance of the means between the two treatments to the variance of the means within each type of treatment. Assuming the null hypothesis to be that neither treatment had any significant effect on the biomass yields of the plants, the hypothesis tests determined whether or not the null hypothesis should be rejected by quantifying the likelihood of a significant difference between the samples (Gelman, 2005). The ANOVA was run with a 95% level of confidence.

Economic Analysis

After the overall plot yield data was collected economic analysis was performed to determine if *M. x giganteus* could be used on a commercial scale as a biofuel substitute. The analysis centered on cash flow projections for the entire *M. x giganteus* supply chain. Plot size and acquisition cost were estimated based on U.S. Department of Agriculture data. Acquisition cost and useful lives were estimated for planting, harvesting, storage, processing, and transport machinery. Together these data provided for annual expense and debt service data on both a cash flow and accrual basis.

Straight line depreciation was used in the projection of depreciation expense for commercial machinery. Useful lives were estimated at 15 years and based on data from the University of Illinois at Urbana-Champaign. Interest rate and loan-to-value assumptions were based on current market conditions for the state of Maryland. Transportation variable costs were based on current market conditions as well as prices currently available in futures markets. Plant acquisition expense was estimated based on market costs.

Annual revenue was determined by estimating price based on existing fuel prices across a variety of fuel sources. This was used in conjunction with existing yield data to project annual revenue for a commercial enterprise of 64.75 hectares (160 acres) on both agriculturally viable and agriculturally marginal land. Operating margins were expected to increase marginally over a 15 year period based on increased efficiencies of scale.

General Economic Assumptions

Acquisition cost for agriculturally viable land was estimated at $7,000 per acre and acquisition cost for agriculturally marginal land was estimated at $1762 per acre. Based on the average Maryland farm size of 160 acres this implied a $1,120,000 total cost for a plot of agriculturally viable land, and a $281,920 total cost for agriculturally marginal land. Based on current market conditions it was assumed that the acquisition loan would have a loan-to-value of 80%, and be amortized over 30 years at an interested rate of 5.2%.

Processing equipment, which included a dryer, pellet mill, pellet cooler, and other miscellaneous equipment was estimated to have an aggregate cost of $797,000. Variable processing costs of $11.30 per ton were estimated based on prevailing hourly wage rates and fuel price projections. These costs remained the same for both agriculturally viable and marginal land.

Transportation equipment was also estimated at current fair market value. A loader was estimated at $82,000 and a truck at $100,000. Additional fixed transportation costs were estimated at $13,148 and variable costs were estimated based on projected travel distance at $0.70 per mile.

Revenue was projected using a cross-section of fuel source prices over a 40 year period and averaging data qualifying the quantitative estimates with particular attention to biomass fuel price behavior. This analysis led us to a range of illustrative prices for *M. x giganteus.* These prices help to drive the different projection scenarios.

Context of Anticipated Results

It is anticipated that *M. x giganteus* planted with the polymer on the fertile soil will yield more biomass than those planted without the polymer in the fertile soil, and that those planted with polymer in the agriculturally marginal land will have greater biomass yield than those planted without (Abd El-Rehim et al., 2004). It is also predicted that the *M. x giganteus* planted on fertile soil will generate more biomass per unit area than the marginal land, but it is hypothesized that that this lower amount of debt service will compensate for the reduced yield.

If this is the case, then *M. x giganteus* can be grown on land that is otherwise considered unusable, which would leave fertile land available for other crops. *M. x giganteus* could thus provide a practical and efficient means to produce biofuel without further decreasing land resources. A study examining the viability of *M. x giganteus* in agriculturally marginal land in Maryland, and more generally, eastern United States, using water absorbent polymer has not been done before; in fact, a study taking into consideration Maryland climate on any aspect of growing *M. x giganteus* is not found in current scientific literature. Many studies in the literature were performed in Europe, while the number of North American studies is relatively small. The results of this data may support the theory that the climate differences between the two continents are not significant and thus allow European data to be applied to America.

Previous literature has pointed out the inefficiency of using ethanol-based fuels. If experimental results suggest that *M. x giganteus* is a viable and more energy-saving alternative, it may replace energy maize as the crop of choice to grow for the alternative-fuel industry. Demand for petroleum products is projected to increase from 85.7 million barrels per day in 2008 to 112.2 million barrels per day in 2035 (Conti and Holtberg, 2011). Since petroleum fuels are non-renewable, increasing demand and decreasing supply will be unsustainable. Even with the help of alternative fuel and energy sources such as energy maize, projected energy goals will not be met. It is anticipated that *M. x giganteus* will show itself as a viable and possibly superior alternative to energy maize and other current energy crops by being more suitable to unutilized land and being capable of producing more energy.

CHAPTER 4: RESULTS

Results

Soil Test Results

Soil tests measure soil pH and nutrient levels. A basic soil test that gives values for soil pH, phosphate, potassium and magnesium levels (Clement and Traunfeld, 1996) was run by the University of Delaware soil test laboratory.

Soil texture is based on the percentage of sand, silt and clay particles in the soil. The largest particles are classified as sand, intermediate particles are classified as silt, and the smallest particles as clay. Soil texture influences the amount of pore space, which in turn influences the amount of water and air in the soil. Soil texture also influences the nutrient holding capacity and the amount of lime needed to correct soil acidity. Soils with high percentage of clay have smaller pore spaces, and hold water and nutrients more tightly than sandy soils.

Organic matter is a vital contributor to soil aggregation. Organic matter also slowly releases nutrients, and increases microbial activity in the soil.

Soil pH is a measure of how acidic (sour) or basic (sweet) the soil is. Soil pH directly affects nutrient availability. The pH scale ranges from 0-14 with 7 as neutral. Numbers less than 7 indicate acidity, while numbers greater than 7 are basic.

Nutrients for healthy plant growth are divided into three categories: primary, secondary, and micronutrients. Nitrogen (N), phosphorus (P), and potassium (K) are primary nutrients that are needed in fairly large quantities. Calcium (Ca), magnesium (Mg), and sulfur (S) are secondary nutrients that are used in lesser quantities. Micronutrients are required in very low amounts and include copper (Cu), iron (Fe), boron (B), manganese (Mn), zinc (Zn), molybdenum (Mo), and chlorine (Cl).

The Brandywine soils (poor soil site) are soils from sand and gravel mining activity in the 1980s. The site on which the *M. x giganteus* was planted was used as a heavy equipment parking area. As such, it is expected that soil compaction is significant. The Woodstock soil is an abandoned garden area with relatively well-developed soil.

Six samples were collected from each of the two sites. One Brandywine sample was too full of stones to be useful and was discarded. Table 1 presents the soil test results for each sample and the aggregated values for each site.

Table 6. Values and univariate statistics for selected soil test parameters.
Brandy: Brandywine site samples. Wood: Woodstock site samples.

Sample ID	pH	OM (%) by LOI	Est. CEC (meq/100g)	Sample ID	pH	OM (%) by LOI	Est. CEC (meq/100g)
				Wood 1	5.6	2.4	6.8
Brandy 1	6.9	1.0	6.7	Wood 2	5.3	2.8	7.8
Brandy 2	7.5	1.2	11.6	Wood 3	5.8	2.7	8.8
Brandy 3	7.3	1.4	10.1	Wood 4	5.6	2.5	7.2
Brandy 4	7.9	1.0	16.8	Wood 5	5.4	2.4	7.1
Brandy 5	7.3	1.2	9.1	Wood 6	5.6	2.4	7.6
Average	7.4	1.2	10.9	Average	5.6	2.5	7.6
S.D.	0.3	0.1	3.4	S.D.	0.2	0.2	0.6
Min	6.9	1.0	6.7	Min	5.3	2.4	6.8
Max	7.9	1.4	16.8	Max	5.8	2.8	8.8
CV	0.04	0.13	0.31	CV	0.03	0.06	0.09

Brandywine soils are only approximately 30-40 years old and were originally formed on marine sediments. There were some shell fragments in some samples. The pH is above neutral (7.0), which is somewhat unusual for soils in the humid region, but is probably due to the marine formation and the calcium content associated with the shells. The organic matter content is low by agricultural soil standards. Because no long history of plant growth exists above and near this material and there has never been any organic matter added, a low organic matter content is reasonable. The organic matter content of the Woodstock site is typical of many Maryland soils.

Both soils have relatively low cation exchange capacities (CEC). The average values are normally associated with sands and are associated with lower fertility and/or lower organic matter content. Though neither soil has a particularly high CEC, the Brandywine site seems a little better off, which is a bit odd because the Woodstock site is the abandoned agricultural soil, thought to be better for plant growth. The variation in CEC at the Brandywine site is much higher than at the Woodstock site (see coefficient of variation (CV) in table above)

The soil test results provided values for phosphorus, potassium, calcium, magnesium, manganese, zinc, copper, iron, boron, sulfur, and aluminum. Soil tests do not provide measurements of nitrogen. The chemical concentrations in the samples are presented in the table below.

Table 7. Values and univariate statistics for selected soil test chemical parameters.
Brandy: Brandywine site samples. Wood: Woodstock site samples.

	M3-P (mg/kg)	M3-K (mg/kg)	M3-Ca (mg/kg)
Brandy 1	14.05	31.94	843.61
Brandy 2	8.51	30.28	1841.94
Brandy 3	11.53	36.40	1449.01
Brandy 4	11.14	40.67	3019.77
Brandy 5	7.11	32.17	1324.85
Average	10.5	34.3	1695.8
SD	2.4	3.8	734.7
Minimum	7.1	30.3	843.6
Maximum	14.1	40.7	3019.8
CV	0.23	0.11	0.43
Wood 1	15.80	171.54	506.18
Wood 2	31.78	255.38	535.17
Wood 3	99.93	264.47	809.58
Wood 4	31.22	202.59	583.41
Wood 5	42.05	220.42	482.36
Wood 6	96.30	271.09	607.08
Average	52.8	230.9	587.3
SD	32.9	36.0	108.1
Minimum	15.8	171.5	482.4
Maximum	99.9	271.1	809.6
CV	0.62	0.16	0.18

The phosphorus values were considerable lower for the Brandywine site. The potassium values were also considerably lower for Brandywine than for the Woodstock site. These two nutrients are two of the three major nutrients needed for plant growth, with nitrogen being the third. Based only on these nutrient values, we expect to see better plant growth at the Woodstock site than at the Brandywine site.

Other nutrients were also determined and univariate statistics are in the table below without including all sample values.

Table 8. Univariate statistics for selected soil test chemical parameters.

Brandywine	M3-B (mg/kg)	M3-S (mg/kg)	M3-Al (mg/kg)	M3-Mg (mg/kg)	M3-Mn (mg/kg)	M3-Zn (mg/kg)	M3-Cu (mg/kg)	M3-Fe (mg/kg)
Average	0.6	38.3	853.4	163.9	68.4	1.0	1.4	184.1
SD	0.1	9.7	27.9	15.8	21.1	0.1	0.2	53.0
Min	0.5	23.0	825.2	141.9	35.7	0.8	1.3	130.7
Max	0.8	50.9	893.3	190.7	95.6	1.1	1.7	275.3
CV	0.21	0.25	0.03	0.10	0.31	0.10	0.12	0.29
Woodstock								
Average	0.5	18.1	975.2	84.6	126.6	2.3	2.0	152.4
SD	0.1	1.1	29.5	23.1	20.2	0.3	0.6	17.3
Min	0.5	16.0	930.7	63.9	105.6	1.8	1.6	126.0
Max	0.7	19.4	1010.5	132.4	165.9	2.9	3.2	182.8
CV	0.11	0.06	0.03	0.27	0.16	0.14	0.28	0.11

The nutrients in the table above are more minor in their impact on plant health. Boron, aluminum, and iron were not remarkably different between the two sites. The Brandywine site was higher in sulfur and magnesium. The Woodstock site was higher in manganese, zinc, and copper. The subtleties of the impact of each nutrient on *M. x giganteus* growth and development are beyond the scope of this study.

Mass Yields Per Plant

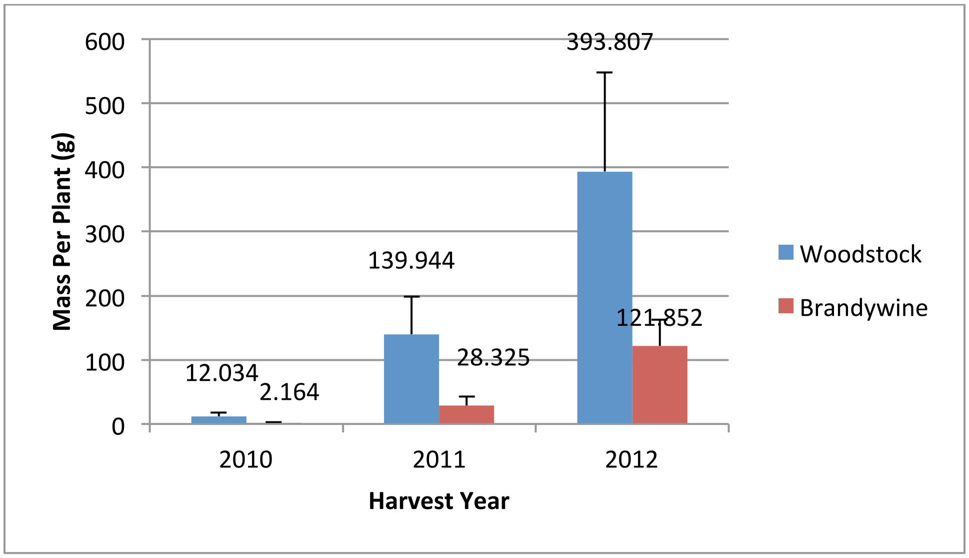


Figure 14. Mean mass per plant versus harvest year at Woodstock (blue) and Brandywine (red), along with error bars representing one standard deviation

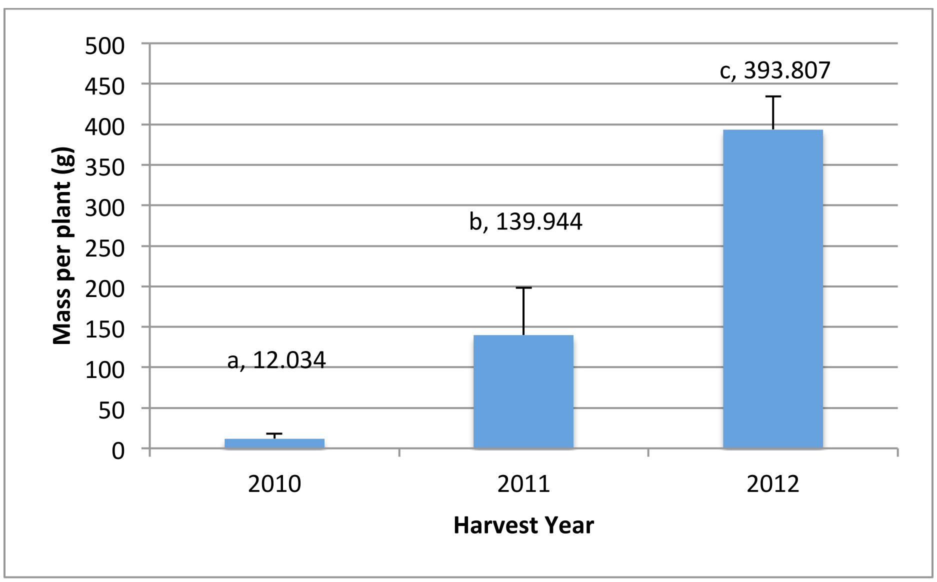


Figure 15. Mean mass per plant versus harvest year at Woodstock, along with error bars as well as the results of the Tukey range test (represented by the lettering above the error bars). Since all three letters are different, it signifies that all three mass per plant means are significantly different.

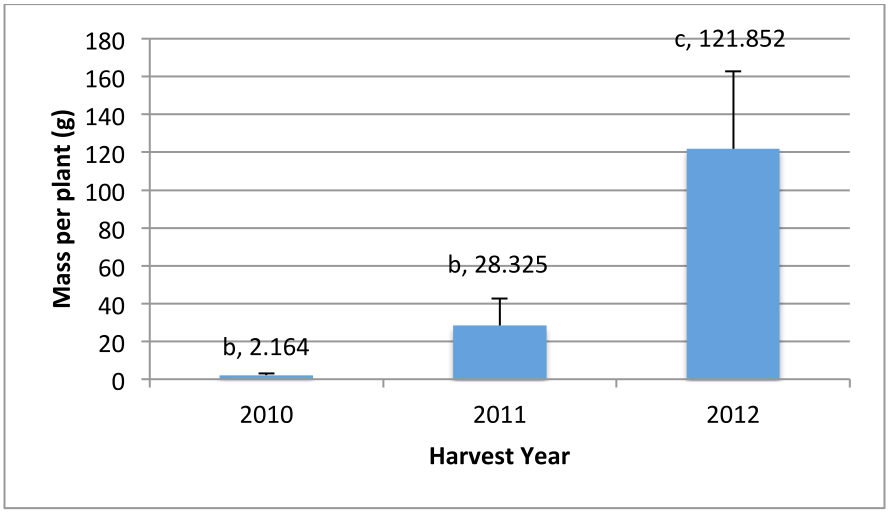


Figure 16. Mean mass per plant versus harvest year at Brandywine, along with error bars as well as the results of the Tukey range test (represented by the lettering above the error bars). Since all three letters are different, it signifies that all three mass per plant means are significantly different.

There are multiple ways that the viability of *M. x giganteus* is judged, both by the presence of polymer in the soil and the soil quality itself. Firstly, since the masses of each row's plants were obtained (separating out the masses of polymer and non-polymer plants), it is a simple comparison to see whether the presence of polymer boosted the mass yield of *M. x giganteus.* Two types of statistical tests were conducted: 2-sample t-tests and ANOVAs, on the data. A test was initially conducted to see if over the two initial years of data, the mass data from Woodstock was indeed different from the mass data from Brandywine.

Table 9. A comparison of the p-values from analysis of the Brandywine biomass yield data and the Woodstock biomass yield data from the 3 years of harvesting. α (significance level)=0.05

Plot	P-value
Woodstock v Brandywine (2010)	$5.62x10^{-6}$
Woodstock v Brandywine (2011)	$1.04x10^{-6}$
Woodstock v Brandywine (2012)	$2.73x10^{-6}$

Indeed, it is clear from the p-value, multiple orders of magnitude smaller than the significance level, that the null hypothesis of there being no difference between Brandywine and Woodstock plant masses, is rejected. Even assuming infinite degrees of freedom, the t-value is also much larger than the threshold value for the differences in the means to not be attributed to simply randomness.

Table 10. The p-values from analysis of biomass yield data from Brandywine in 2010 as compared to 2011, and similarly, Woodstock in 2010 as compared to 2011. $\alpha=0.05$

Plot	P-value
Brandywine (2010) v Brandywine (2011)	1.23×10^{-4}
Woodstock (2010) v Woodstock (2011)	2.69×10^{-7}

Similarly, it is clear that there are clear differences within the data for each plot compared to previous years, which means that the mass differences from year to year within each plot was not due to chance.

Now that it is clear that there are statistically significant differences in mass within a plot from year to year, and in a single year from plot to plot, establishing whether this difference could be due to the presence of polymer is important to answering the research question.

Table 11. A comparison of the p-values of polymer versus nonpolymer plant biomass yields within each plot during one year of harvest. $\alpha=0.05$

Plot (year): Polymer v Nonpolymer	P-value
Woodstock (2010): P v NP	0.398
Brandywine (2010): P v NP	0.819
Woodstock (2011): P v NP	0.132
Brandywine (2011): P v NP	0.995
Woodstock (2012): P v NP	0.219
Brandywine (2012): P v NP	0.548

The results of the t-tests displayed in Table 5 do not lend much credence to the notion that the null hypothesis of there not being non-random differences in polymer plants and nonpolymer plants' biomass yields. In fact, for Brandywine in 2011, it is almost 99.5% likely that the same, if not more extreme, results obtained for the biomass yields for polymer and nonpolymer plants could be obtained assuming the null hypothesis were true. For the other years and other plots, the p-value falls above the set significance level, which means that the null hypothesis cannot be rejected.

Therefore, there are statistically significant differences in biomass yields between Woodstock and Brandywine, and between 2010 and 2011. However, there are no statistically significant differences between the use of polymer and the non-use of polymer. Hence, the application of polymer likely has no significant difference on the biomass yield of *M. x giganteus*. However, it is clear that Woodstock yields much more biomass than Brandywine. Assuming 12100 plants per hectare, the yield for the Woodstock plot would be 4.77×10^6 g. For Brandywine, this value is 1.47×10^6 g.

With respect to the small plots that were planted in the spring of 2010, mass yield data from the 2011 harvest revealed that there was no statistically significant difference between polymer treatments at both plots, nor was there a statistically significant difference between the overall mass at the Woodstock plot and the overall mass at the Brandywine plot.

Table 12. Mean mass per plant and standard deviation of plants at both Woodstock and Brandywine small plots, separated by polymer treatment.

Plot	Polymer Treatment	Average mass per plant (g)	Standard Deviation (g)
Woodstock	polymer	2.3	0.7
	nonpolymer	3.6	2.5
Brandywine	polymer	2.5	1.6
	nonpolymer	3.1	1.7

It should be noted that much biomass could fall off the main stems of the plants prior to harvesting. This is illustrated by the Woodstock 2012 harvest. In one 3 foot by 3 foot square, 151 g of *M. x giganteus* biomass was collected from the ground at the time of harvest. Scaled up to one hectare, the amount lost becomes 1.81×10^6 g. These losses are generally unavoidable as harvesting earlier results in less nutrients being sequestered back into the rhizome.

Energy Content Per Unit Mass

Table 13. Mean energy content and standard deviation of plants at both Woodstock and Brandywine, separated by polymer treatment.

Year	Plot	Mean energy content (cal/g)	Standard Deviation (cal/g)
2010	Woodstock polymer	4250	125.2
	Brandywine polymer	4350	60.0
	Woodstock nonpolymer	4276	123.1
	Brandywine nonpolymer	4313	95.4
2011	Woodstock polymer	4308	106.7
	Brandywine polymer	4264	84.1
	Woodstock nonpolymer	4309	68.0
	Brandywine nonpolymer	4231	51.4
2012	Brandywine polymer	4458	174.3
	Brandywine nonpolymer	4425	48.7

Table 14. Mean energy content and standard deviation at both Woodstock and Brandywine, neglecting polymer treatment

Year	Plot	Mean energy content (cal/g)	Standard Deviation (cal/g)
2010	Woodstock	4264	123.1
	Brandywine	4329	83.5
2011	Woodstock	4309	88.2
	Brandywine	4246	69.1
2012	Brandywine	4442	125.3

The energy content of the plants, determined through calorimetry, was first used to see if there was any statistical significance between harvests.

Table 15. The p-values of the statistical analysis of calorimetry mean energy contents, ignoring application of polymer. α=0.05

Plot	P-value
Brandywine v Woodstock (2010)	0.0087
Brandywine v Woodstock (2011)	0.00156

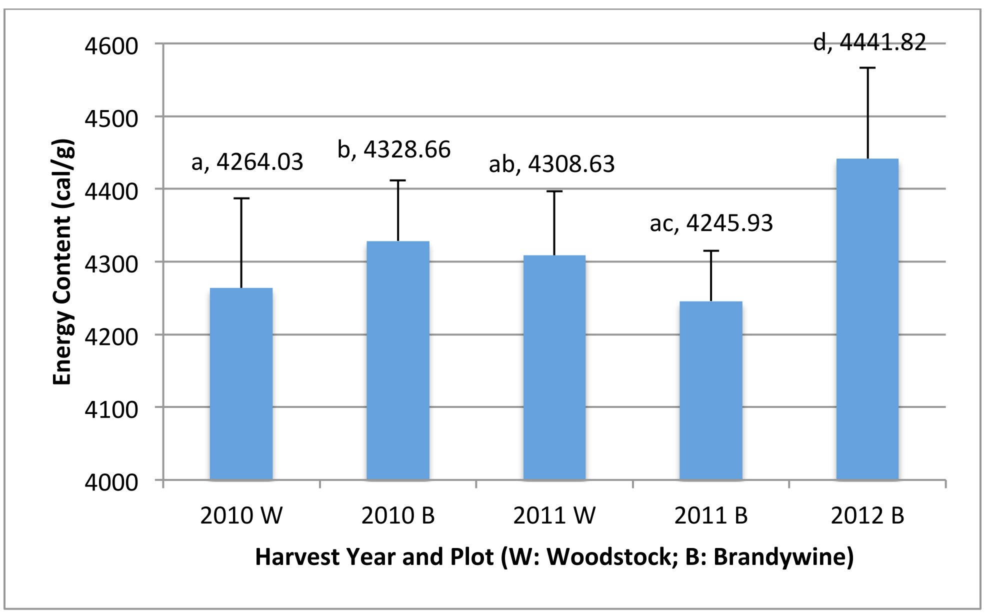


Figure 17. Mean plant energy content versus harvest year at Woodstock (W) and Brandywine (B), along with error bars as well as the results of the Tukey range test (represented by the lettering above the error bars).

Since there is statistical significance between Brandywine and Woodstock plots in terms of the energy content of plants, it can conjectured that there is some physiological difference between Brandywine and Woodstock plants that can be the root cause. Since the plants are genetically very similar, coming from the same nursery, genetic causes seem less likely than differences in soil quality leading to different growth of the plants. To investigate whether or not the application of the polymer could result in this difference (i.e. if the polymer's application could mean a plant could have a higher or lower energy per unit mass), the same statistical tests were conducted comparing polymer and nonpolymer plants within each plot.

Table 16. Comparison of statistical test results of calorimetry data for plants with and without polymer within each plot for a given year. α=0.05

Plot (year): Polymer v Nonpolymer	P-value
Woodstock (2010): P v NP	0.515
Brandywine (2010): P v NP	0.166
Woodstock (2011): P v NP	0.987
Brandywine (2011): P v NP	0.197
Brandywine (2012): P v NP	0.60

From this analysis, the null hypothesis that there is no difference in the energetics of polymer plants as opposed to nonpolymer plants cannot be rejected, since the significance level threshold was not achieved. Therefore, the application of polymer did not change the energy yield of a plant by any statistically significant margin. Additionally, to see if there was significance in the calorimetric data from year to year within a plot was investigated.

Table 17. Comparison of statistical test results of calorimetry data for plants with and without polymer within each plot for a given year. α=0.05

Plot	P-value
Brandywine (2010) v Brandywine (2011)	2.86×10^{-5}
Woodstock (2010) v Woodstock (2011)	0.0717
Brandywine (2010) v Brandywine (2012)	0.0019
Brandywine (2011) v Brandywine (2012)	3.00×10^{-6}

Interestingly, it seems that there was a statistically significant difference between all calorimetric data from Brandywine. However, this difference was not present in the Woodstock data, although the p-value is very close to the significance level. The reasoning behind this will be presented in the discussion chapter.

Based on the assumption of 12100 plants per hectare, the annual energy content per hectare that can be expected is 2.04×10^7 kcal for the Woodstock plot. For the Brandywine site, this value is 6.55×10^6 kcal. This projection uses the 2012 harvest average energy content of 4441.81 cal/g.

Height Results

In order to analyze height data from year to year and from plot to plot, the Tukey range test was used to analyze statistical significance. However, 2-sample t-tests were used to determine whether or not application of polymer had a significant difference on the height of plants. It was found that the null hypothesis of height not being affected by the polymer could not be rejected for polymer versus nonpolymer plants for any year in any plot. However, there was strong significance in data showing that there were height differences between Woodstock plants and Brandywine plants.

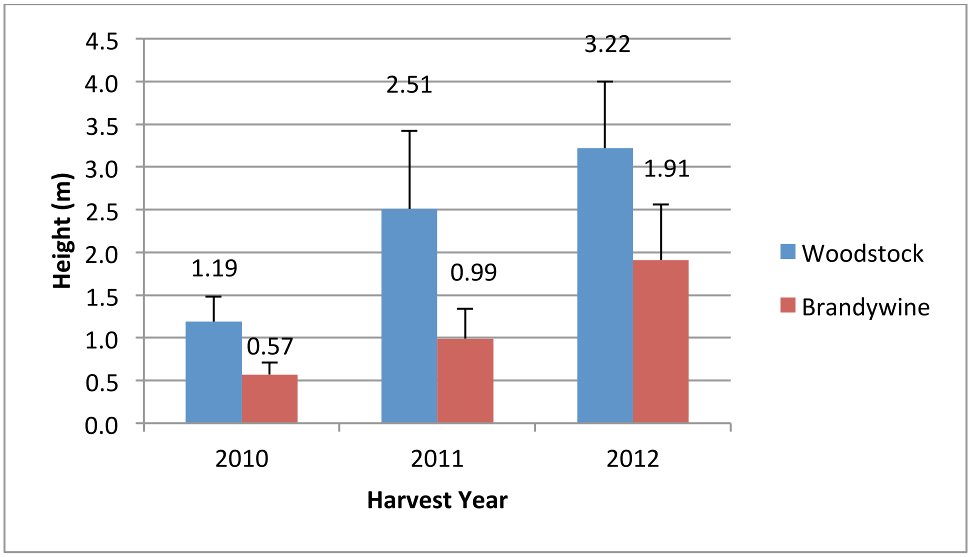


Figure 18. Mean plant height versus harvest year at Woodstock (blue) and Brandywine (red), along with error bars representing one standard deviation.

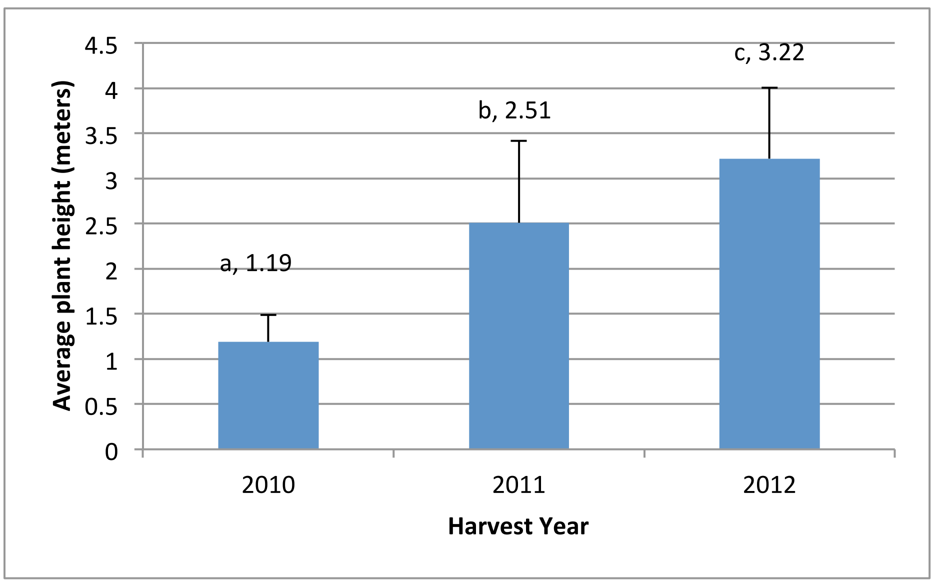


Figure 19. Average plant height versus harvest year at Woodstock, along with error bars as well as the results of the Tukey range test (represented by the lettering above the error bars). Since all three letters are different, it signifies that all three height mean differences are significant.

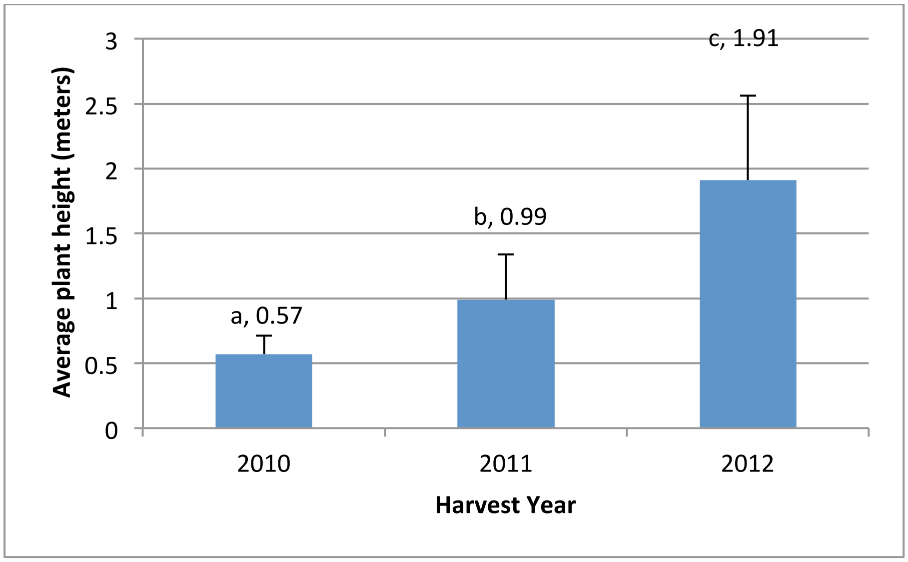


Figure 20. Average plant height versus harvest year at Brandywine, along with error bars as well as the results of the Tukey range test (represented by the lettering above the error bars). Since all three letters are different, it signifies that all three height mean differences are significant.

The data also shows that on average, Woodstock plants are taller than Brandywine plants.

Plant Survivability

The survival of the inner plants of the each plot (i.e. those plants that did not reside on an edge of the plot) was recorded for each year, plot, and polymer treatment (Figure 21).

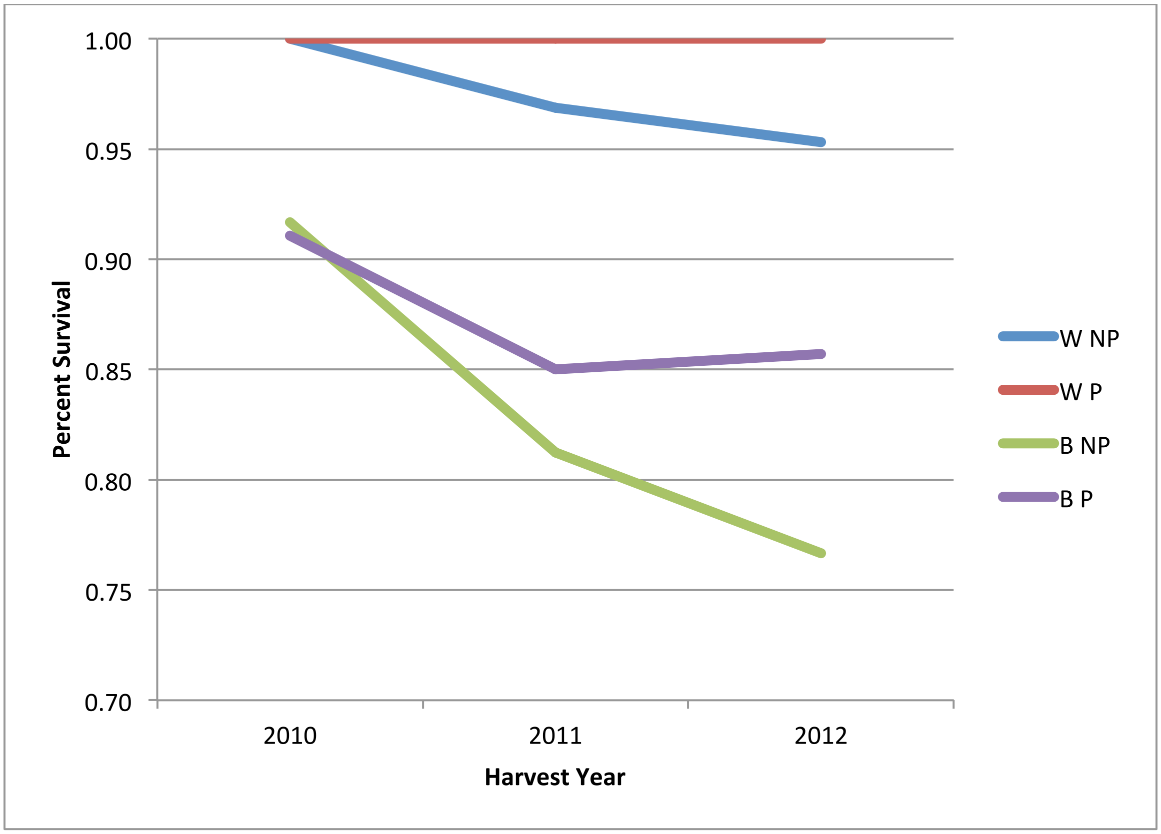


Figure 21. Percent plant survival at each plot (Woodstock: W, Brandywine: B) for each polymer treatment (with polymer: P, without polymer: NP) and for each harvest year.

The Woodstock plot showed the best overall survival percentage, never dipping below 95%. On the other hand, Brandywine showed more considerable losses with up to 23.3% plant death over three years. It appears, based on the figure, that the presence of CLP is correlated with greater percent survival of the plants receiving this treatment compared to those that did not receive the polymer. On a side note, the slight increase in plant survival percentage for the Brandywine plants that received CLP is attributed to the possibility that some plants were mistakenly counted as being dead in 2011, when in fact they were not.

Economic Results

Scenario One (Existing Price): $56.02/ton

Based on current market prices for biofuel sources an existing price that *M. x giganteus* could be sold for today is $56.02/ton. This was used as a base case in estimating crop profitability. In addition, multiple expense scenarios were considered that ranged from full acquisition of the land and all necessary equipment to a 100% land subsidy and the assumption that all machinery was already owned. The resulting profitability calculations were as follows. A detailed income statement and cash flow statement are included in the appendix to this section.

Table 18. Case one profitability calculations

Case One Profitability Calculations

	Existing Price		
Viable Land	*Worst Case*	*Base Case*	*Best Case*
IRR	N/A	N/A	(5.7)%
NPV	$ (1,886,270)	$ (974,218)	$ (56,776)
Marginal Land			
IRR	N/A	N/A	N/A
NPV	$ (1,580,209)	$ (907,279)	$ (234,348)
Assumptions			
Discount Rate	5.0%	5.0%	5.0%
Land Subsidy	0.0%	50.0%	100.0%
Equipment Purchase	100.0%	50.0%	0.0%
$ / Ton	$ 56.02	$ 56.02	$ 56.02

IRR, or internal rate of return, is a profitability measure that calculates the discount rate at which the net present value of all cash flows associated with the project is zero. NPV, or net present value, is a summation of the total discounted value of all cash flows that the project will generate over its life. An IRR value of "N/A" in the table suggests that the project never reached positive cash flow. IRR and NPV are used as common decision making tools when evaluating capital projects. In order to accept a project its IRR should be higher than the discount rate, and the net present value of the cash flows should be positive.

Case One resulted in a project with severely negative NPV under all expense assumptions for both agriculturally marginal and viable land, and only achieved positive cash flow under the assumptions of 100% land subsidy and 0% equipment acquisition for agriculturally viable land. It is unlikely that a project with these return characteristics would be accepted.

Scenario Two (Approximate Doubling of the Price): $160.07/ton

Given the poor results of case one, it was important to sensitize the projections to see at what point a commercial *M. x giganteus* project would become viable. To that end, a price based on more expensive fuel sources that was approximately two times the projected existing market price for *M. x giganteus* was used in the calculations.

The results were more encouraging, but the project was still unable to achieve positive cash flows under all expense assumptions for marginal land. For the viable land plot under full expense assumptions as well as half-expense assumptions, the project did achieve positive cash flows but had a severely negative IRR and NPV, suggesting that similar to the existing price scenario this project would not be accepted. If, however, the most favorable expense assumptions were used (100% land subsidy, 0% equipment acquisition) the project became extremely profitable. Under these assumptions the project produced a 49.6% IRR which was well above the 5.0% discount rate assumption for this endeavor. Likewise the project's NPV was $485,749.

Table 19. Case two profitability calculations.

Case Two Profitability Calculations			
	Approx. Double Existing Price		
Viable Land	*Worst Case*	*Base Case*	*Best Case*
IRR	(16.7)%	(6.7)%	49.6%
NPV	$ (1,465,035)	$ (552,983)	$ 485,749
Marginal Land			
IRR	N/A	N/A	N/A
NPV	$ (1,478,741)	$ (805,810)	$ (132,879)
Assumptions			
Discount Rate	5.0%	5.0%	5.0%
Land Subsidy	0.0%	50.0%	100.0%
Equipment Purchase	100.0%	50.0%	0.0%
$ / Ton	$ 160.07	$ 160.07	$ 160.07

Despite these encouraging results, it is unlikely that such expense conditions would be achievable and, therefore, under this scenario the project would again likely be rejected.

Scenario Three (Approximate Tripling of the Price): $240.10/ton

Further sensitivity analysis was performed using still more expensive fuel sources as proxies for *M. x giganteus* to find a projected sale price of approximately three times the existing price for the crop.

Table 20. Case three profitability calculations

Case Three Profitability Calculations			
	Approx. Triple Existing Price		
Viable Land	*Worst Case*	*Base Case*	*Best Case*
IRR	(7.4)%	2.7%	82.1%
NPV	$ (1,091,173)	$ (141,544)	$ 971,728
Marginal Land			
IRR	(22.5)%	(15.5)%	12.7%
NPV	$ (1,315,557)	$ (642,626)	$ 62,233
Assumptions			
Discount Rate	5.0%	5.0%	5.0%
Land Subsidy	0.0%	50.0%	100.0%
Equipment Purchase	100.0%	50.0%	0.0%
$ / Ton	$ 240.10	$ 240.10	$ 240.10

This scenario showed still more encouraging results achieving a positive IRR under base case expense assumptions for viable land and best case expense assumptions for marginal land. The following table summarizes IRR at varying levels of land subsidy and equipment acquisition.

Table 21. Viable land IRR heat map (scenario three).

Viable Land IRR Heat Map (Scenario Three)

		% Land Purchased										
		0.0%	*10.0%*	*20.0%*	*30.0%*	*40.0%*	*50.0%*	*60.0%*	*70.0%*	*80.0%*	*90.0%*	*100.0%*
% Equipment Purchased	*0.0%*	82.1%	60.0%	46.9%	38.0%	31.5%	26.3%	22.0%	18.4%	15.3%	12.5%	10.0%
	10.0%	36.5%	31.0%	26.5%	22.7%	19.3%	16.4%	13.8%	11.5%	9.3%	7.3%	5.5%
	20.0%	23.9%	20.8%	18.1%	15.6%	13.3%	11.2%	9.3%	7.5%	5.8%	4.2%	2.6%
	30.0%	17.1%	14.9%	12.9%	11.0%	9.2%	7.6%	6.0%	4.5%	3.1%	1.8%	0.5%
	40.0%	12.6%	10.9%	9.2%	7.7%	6.3%	4.9%	3.5%	2.3%	1.0%	(0.1)%	(1.3)%
	50.0%	9.2%	7.8%	6.5%	5.1%	3.9%	2.7%	1.5%	0.4%	(0.7)%	(1.7)%	(2.8)%
	60.0%	6.6%	5.4%	4.2%	3.1%	2.0%	0.9%	(0.1)%	(1.1)%	(2.1)%	(3.0)%	(4.0)%
	70.0%	4.5%	3.4%	2.4%	1.4%	0.4%	(0.6)%	(1.5)%	(2.4)%	(3.3)%	(4.2)%	(5.0)%
	80.0%	2.7%	1.8%	0.8%	(0.1)%	(1.0)%	(1.8)%	(2.7)%	(3.5)%	(4.4)%	(5.2)%	(5.9)%
	90.0%	1.2%	0.4%	(0.5)%	(1.3)%	(2.2)%	(3.0)%	(3.7)%	(4.5)%	(5.3)%	(6.0)%	(6.7)%
	100.0%	(0.1)%	(0.9)%	(1.7)%	(2.4)%	(3.2)%	(3.9)%	(4.6)%	(5.4)%	(6.1)%	(6.7)%	(7.4)%

Table 22. Marginal land IRR heat map (scenario three).

Marginal Land IRR Heat Map (Scenario Three)

		% Land Purchased										
		0.0%	*10.0%*	*20.0%*	*30.0%*	*40.0%*	*50.0%*	*60.0%*	*70.0%*	*80.0%*	*90.0%*	*100.0%*
% Equipment Purchased	*0.0%*	12.7%	10.0%	7.6%	5.3%	3.2%	1.2%	(0.7)%	(2.5)%	(4.2)%	(5.9)%	(7.6)%
	10.0%	(1.5)%	(2.6)%	(3.7)%	(4.8)%	(5.9)%	(7.0)%	(8.0)%	(9.1)%	(10.2)%	(11.3)%	(12.4)%
	20.0%	(6.1)%	(7.0)%	(7.8)%	(8.6)%	(9.4)%	(10.3)%	(11.1)%	(12.0)%	(12.9)%	(13.8)%	(14.8)%
	30.0%	(9.0)%	(9.7)%	(10.4)%	(11.1)%	(11.8)%	(12.5)%	(13.3)%	(14.0)%	(14.8)%	(15.7)%	(16.5)%
	40.0%	(11.0)%	(11.6)%	(12.2)%	(12.9)%	(13.5)%	(14.2)%	(14.9)%	(15.6)%	(16.3)%	(17.1)%	(17.9)%
	50.0%	(12.6)%	(13.1)%	(13.7)%	(14.3)%	(14.9)%	(15.5)%	(16.2)%	(16.8)%	(17.5)%	(18.2)%	(19.0)%
	60.0%	(13.9)%	(14.4)%	(14.9)%	(15.5)%	(16.0)%	(16.6)%	(17.2)%	(17.8)%	(18.5)%	(19.2)%	(19.9)%
	70.0%	(14.9)%	(15.4)%	(15.9)%	(16.5)%	(17.0)%	(17.6)%	(18.1)%	(18.7)%	(19.3)%	(20.0)%	(20.7)%
	80.0%	(15.9)%	(16.3)%	(16.8)%	(17.3)%	(17.8)%	(18.4)%	(18.9)%	(19.5)%	(20.1)%	(20.7)%	(21.4)%
	90.0%	(16.7)%	(17.1)%	(17.6)%	(18.1)%	(18.6)%	(19.1)%	(19.6)%	(20.2)%	(20.8)%	(21.4)%	(22.0)%
	100.0%	(17.4)%	(17.8)%	(18.3)%	(18.8)%	(19.2)%	(19.7)%	(20.2)%	(20.8)%	(21.3)%	(21.9)%	(22.5)%

CHAPTER 5: DISCUSSION

Discussion

Agricultural Implications

The results show that the arable plot (Woodstock) was far more productive compared to the agriculturally marginal plot (Brandywine). The yield per hectare of the Woodstock plot (4.77×10^6 g) was 3.24 times greater than the yield per hectare of the Brandywine plot (1.47×10^6 g). This suggests that arable land is better for growing more *M. x giganteus* with more mass per plant. In addition, 57.6% of plants at Woodstock reached the mature height of 3 m or more whereas only 2 plants reached close to that height (2.95 m) on the Brandywine plot. The Woodstock plants were clearly taller and more robust with the sprouting of many more stalks in a given plot area. A contributor to the drastic difference in productivity is the quality of the soil. In addition to the clay and packed soil, stones and sand were evident at the Brandywine plot. With such obvious differences in productivity, agriculturally marginal land would have to be augmented in some way to even approach the levels of productivity from arable land.

Due to the fact that there was no statistically significant difference between the mass per plant values for the polymer treatments at each site, it can be concluded that the spacing of the plants in the larger plots was adequate to prevent one plant without CLP from drawing benefits from the CLP around a neighboring plant. This demonstrates that the design of the larger plot is valid and that the polymer around one plant does not affect the nearby plant that lacks polymer. Conclusions concerning the effect of the CLP in the larger plot are thus still valid.

As the results indicate, no statistically significant difference was found between the means for height, mass per plant, or calorimetry for the polymer and nonpolymer plants for the respective plot and year. This suggests that there is no advantage to using polymer in non-water limiting conditions. The Maryland climate is not dry enough to justify the use of CLP. The plots were irrigated during the transplantation process (first season) and watering was subsequently left to natural precipitation.

The energy content values of the Woodstock plants were statistically consistent across two years. However, at Brandywine, no mean values for each harvest year were consistent. This could be due to the fact that as the plant grows taller, the plant produces more lignin to strengthen each stalk to allow it to grow taller. Between the 2011 and 2012 harvests at Brandywine, the mean height of the plants nearly doubled. As such, this explanation for the increase in energy content is plausible.

Field Variables

Both the Brandywine and Woodstock sites contain several confounding variables. The amount of light that the plants received was different at each plot. At Brandywine, the plot receives full sun with no shade from trees at any point in the day. In contrast, the western side of the Woodstock plot has a row of 75-foot tall pine trees roughly fifteen feet from the nearest *M. x giganteus* plant, which cast shadows over the plot of *M. x giganteus* around sunset.

The Woodstock plot also has a slight incline. Most of the plants were planted at the flattest part of the area, but some of the plants were placed on a section of the plot that slopes upward. This could have allowed the plants at the bottom of the incline to receive more rainwater, since the water will run down the slope to the flatter area. The plot at Brandywine, however, is completely level, allowing for even reception of rainwater.

Since Brandywine and Woodstock are about 67.6 km apart, the daily temperature and precipitation at both sites differed. Differences in the amount of water received by the plants was not a variable in this experiment since as much water as was needed was given, assuming that a similar quantity will be given in industrial production.

Finally, the soil composition within each plot differed. At Woodstock, the soil composition is uniform throughout the plot. At the Brandywine plot, the soil on the southern side of the plot is sandier than the soil on the northern side.

During the planting process, the plants were planted at differing depths and with different tools. In Brandywine, about half the plants were planted in holes dug with an auger, which produced three-inch diameter vertical shafts. The other plants were planted in holes dug with shovels, which created a paraboloid-like depression in the ground. The auger-produced holes were deeper than the holes created with the shovels. In Woodstock, all of the holes were dug with shovels and at more consistent depths.

Some of the plants with polymer had some of the polymer exposed on the surface. Ten plants at the Woodstock plot and at least one plant at Brandywine had exposed polymer. UV light has been demonstrated to increase the rate of cross-linked polyacrylamide degradation, thereby decreasing the water-absorbing capacity of the

UV-damaged polymer (Holliman et al., 2005). In this study, exposed polymer was not re-covered because in large-scale productions, any exposed polymer would not be re-covered by the operator (Felton, Personal communication).

Two months after the plants were planted in Woodstock, the plot was overgrown with weeds. Some of the weeds included *Artemisia vulgaris*, common wormwood; *Polygonum perfoliatum*, mile-a-minute weed; *Cyperus esculentus*, yellow nutsedge; and *Setaria faberi*, giant foxtail, which was the most prevalent. *S. faberi* is an annual grass native to Asia that grows to a maximum height of seven feet (Lanini and Wertz, 1980). These plants grew to a comparable height to the *M. x giganteus* present at the Woodstock plot at the time. The *S. faberi* and the *M. x giganteus* probably competed for light, water, and soil nutrients. This competition was most likely not significant enough to harm the *M. x giganteus*, but the plants in Brandywine did not experience a similar competition with weeds. In Brandywine, the weeds were minor, small grasses that were not substantial enough to provide heavy competition with the *M. x giganteus*. Competition with weeds was not a problem in the second growing season. From the second growing season onward, the canopy of *M. x giganteus* prevented the growth of most weeds by blocking sunlight from reaching the ground.

M. x giganteus as a Commercial Enterprise

To evaluate *M. x giganteus'* potential to participate in a burgeoning biofuels production industry it was important to analyze the crop from a commercial standpoint. It was reviewed in terms of profitability and potential cash flow for a production facility in Maryland on both agriculturally viable land and agriculturally marginal land. *M. x giganteus* was evaluated under three scenarios with different revenue and expense assumptions.

Implications

Interestingly, in Scenario One (Existing Price Revenue Calculation), the marginal land plot preforms better than the agriculturally viable land. This speaks to the significance of the debt service in the profitability of a commercial *M. x giganteus* enterprise. The only significantly different input for the marginal land plot is acquisition cost of land. The total acquisition cost for 160 acres of marginal land was only 25.1% the cost of the same amount of agriculturally viable land. Despite significantly lower overall revenue, the marginal land plot has a lower net operating loss and a lower cash balance reduction than the agriculturally viable land on a yearly basis.

This suggests that with lower land acquisition costs the enterprise could potentially become commercially viable. As Scenario One is the most probable given current market conditions, additional analysis was performed to determine the level of subsidization or reduction in land acquisition cost that would be required to make a commercial operation cash flow positive under these revenue assumptions. Current acquisition costs would have to be reduced by 83% to make an agriculturally viable land plot cash flow positive within 15 years. A 100% reduction in acquisition cost results in cash flow positive operations within 9 years. No level of subsidization results in cash flow positive operations over 15 years for agriculturally marginal land.

Without substantial reduction in cost or similar increase in sale price large scale commercial viability of *M. x giganteus* is unlikely.

It is likely that over time market prices for biofuels will increase, especially as production costs for other fuel sources continue to grow. However, given current market conditions, it is unlikely that the required increase in market price will occur to make a commercial *M. x giganteus* production enterprise viable in the near future. In addition, land acquisition costs are projected to increase in the coming years, which would provide a further impediment to profitable operations. Unless the proposed land is currently fully owned, or the government provides significant subsidies, land acquisition cost and a low price point will continue to be prohibitive to a successful *M. x giganteus* enterprise.

With that said, it is important to note that no commercial fertilizers were used in this study and, as a result, there is the possibility that application of such fertilizer would significantly increase yield, which would increase overall profitability. The following table and accompanying chart present hypothetical increases in yield per hectare for both viable and marginal plots, and the resulting profitability metrics.

Table 23. Hypothetical increase in yield per hectare and resulting profitability metrics.

Plot Yield Sensitivity

		Viable Land			*Marginal Land*	
Yield Per Hectare		IRR	NPV	**Yield Per Hectare**	IRR	NPV
	2	N/A	$ (138,068)	**2**	N/A	$ (201,799)
	4	(14.4)%	(82,089)	**4**	N/A	(109,287)
	6	2.5%	(16,348)	**6**	5.2%	1,208
	8	11.8%	53,552	**8**	18.3%	121,088
	10	19.0%	123,822	**10**	28.2%	240,968
	15	33.1%	299,495	**15**	47.7%	540,669
	20	44.6%	475,169	**20**	63.7%	840,370
	25	54.7%	650,843	**25**	77.7%	1,140,071
	30	63.8%	826,517	**30**	90.4%	1,439,772

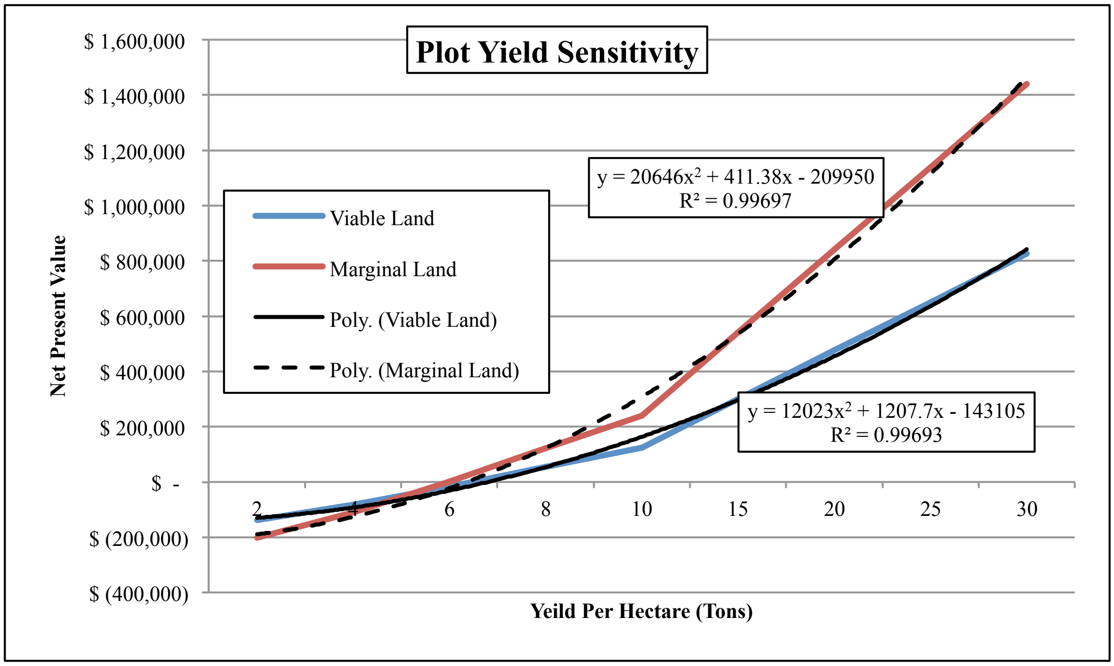


Figure 22. Hypothetical increase in yield per hectare and resulting profitability metrics.

Indeed, even marginal increases in yield result in substantially increased profitability at the existing price level. As yield increases, the Brandywine plot (marginal land) outpaces Woodstock (viable land) in terms of profitability due to its lower cost structure. This suggests that with the application of commercial fertilizer, and a low acquisition cost of marginal land, a *M. x giganteus* operation could be economically viable and quite profitable.

CHAPTER 6: CONCLUSIONS

Conclusions

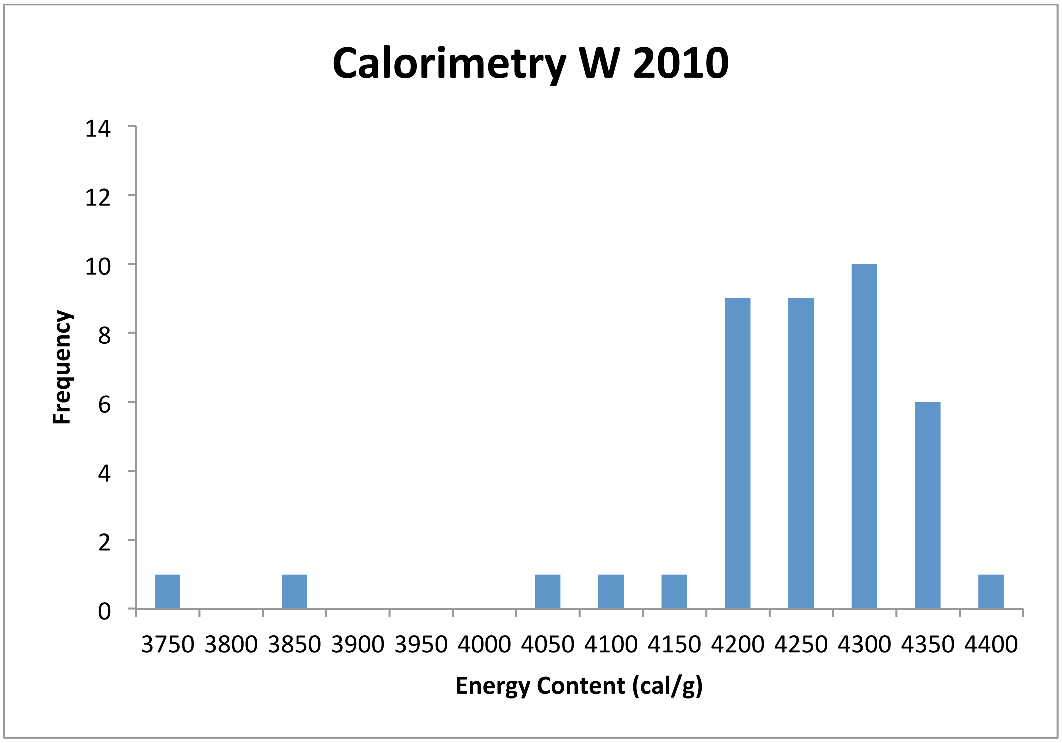
After completing these analyses, the following can be concluded:

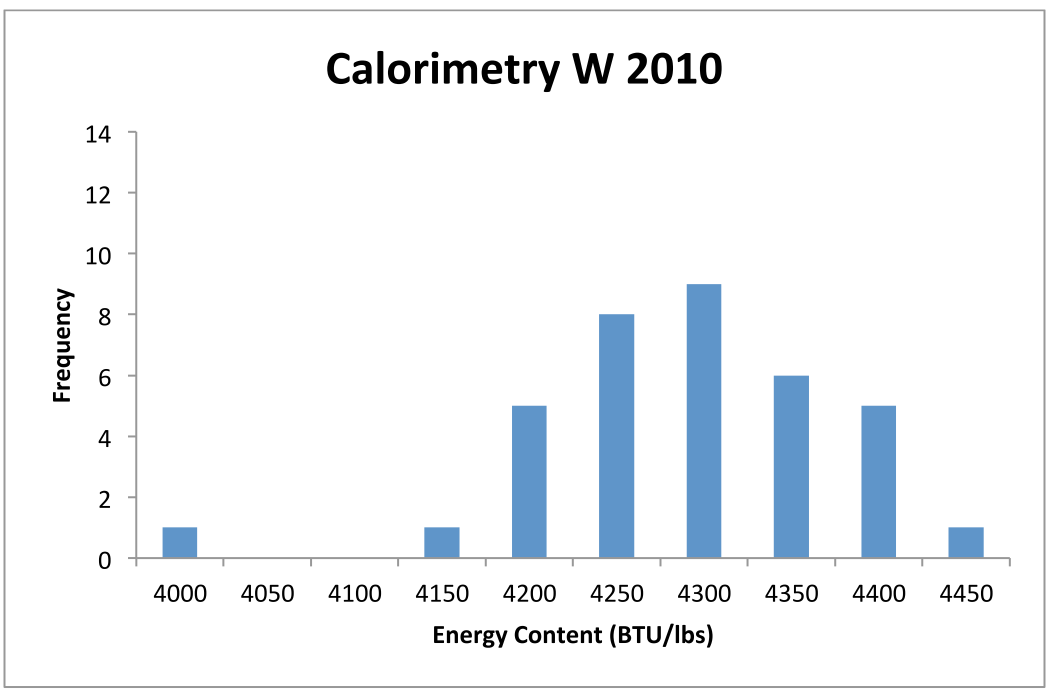
- *M. x giganteus* grows better in agriculturally viable soil than in agriculturally marginal soil, based on the height and mass data.
- In non-water limiting conditions, polymer produces no difference in *M. x giganteus* growth.
- *M. x giganteus* is not an economically viable option for biofuel production on agriculturally marginal lands with the following caveats:
    - The study did not make use of a commercial fertilizer.
    - This conclusion covers only existing price and expense scenarios.

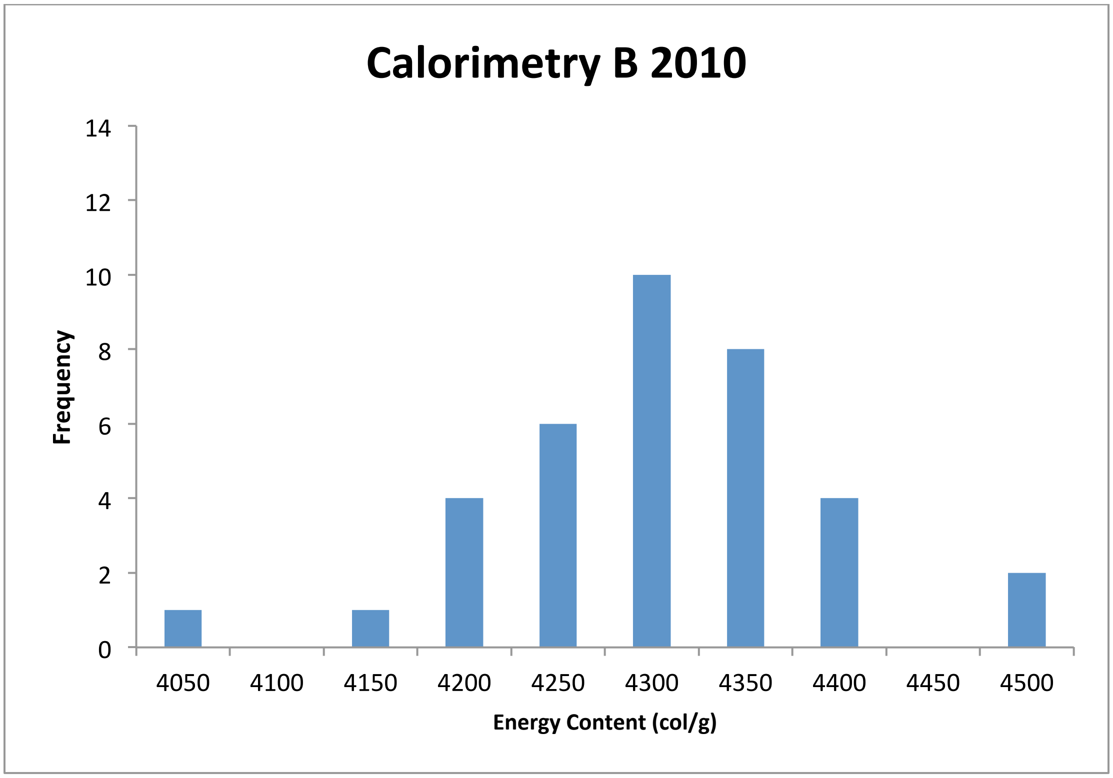
APPENDICES

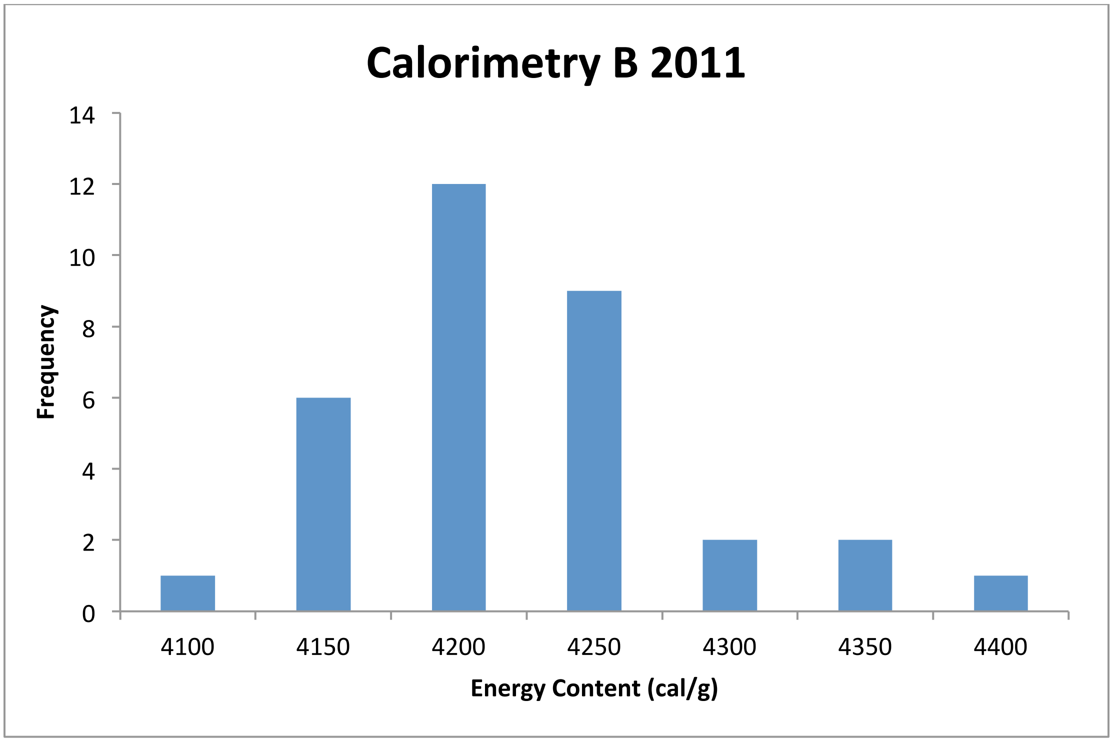
Appendix A: Histograms

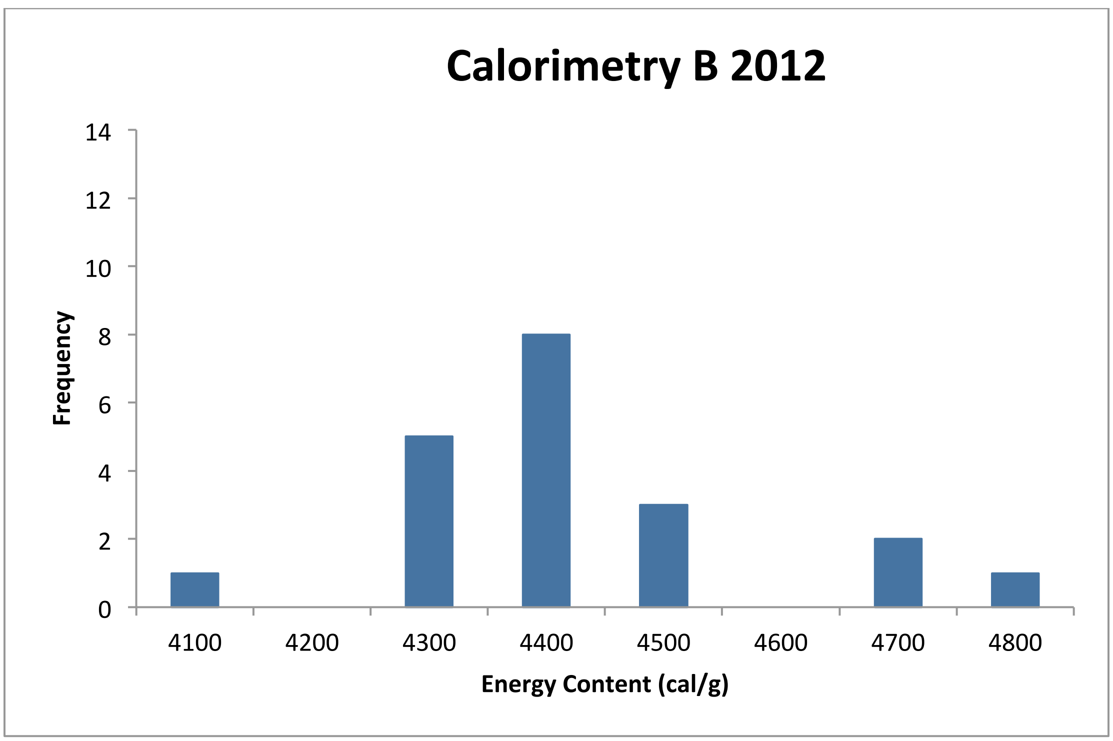
Note: "W" indicates values from the Woodstock viable land plot. "B" indicates values from the Brandywine marginal land plot.

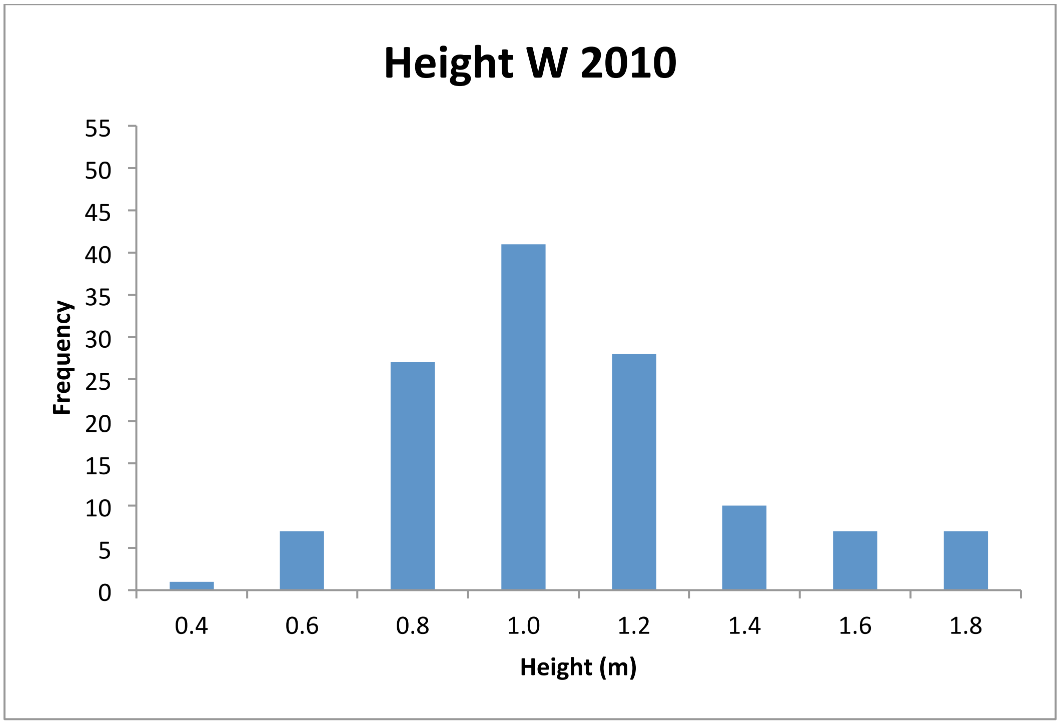


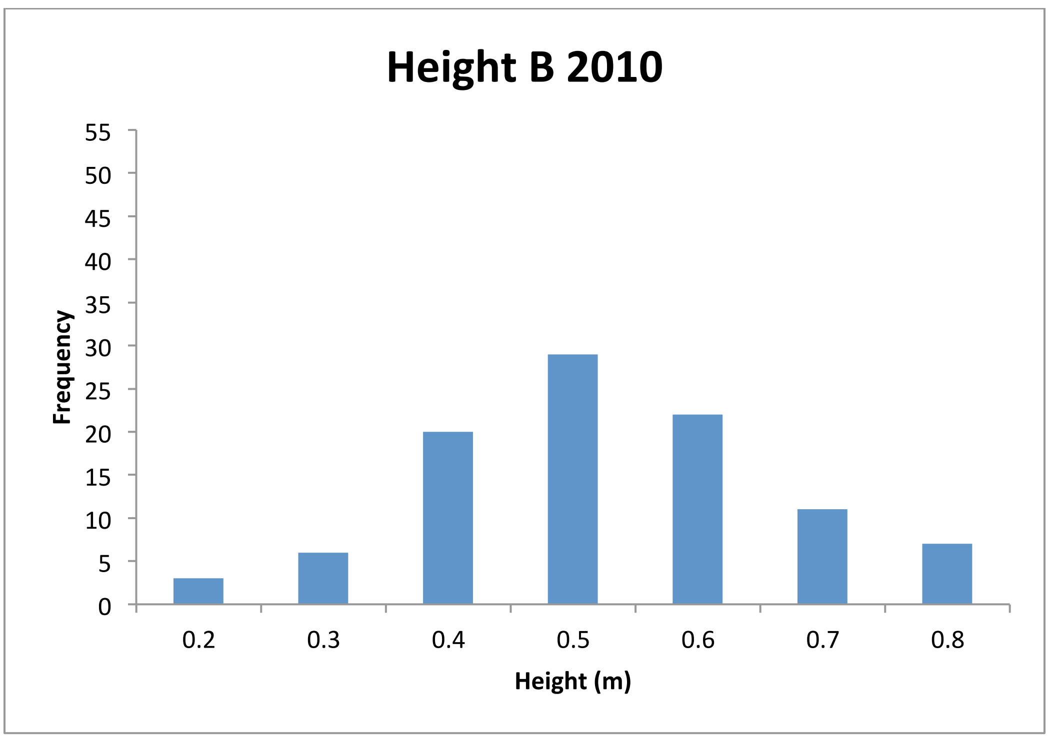


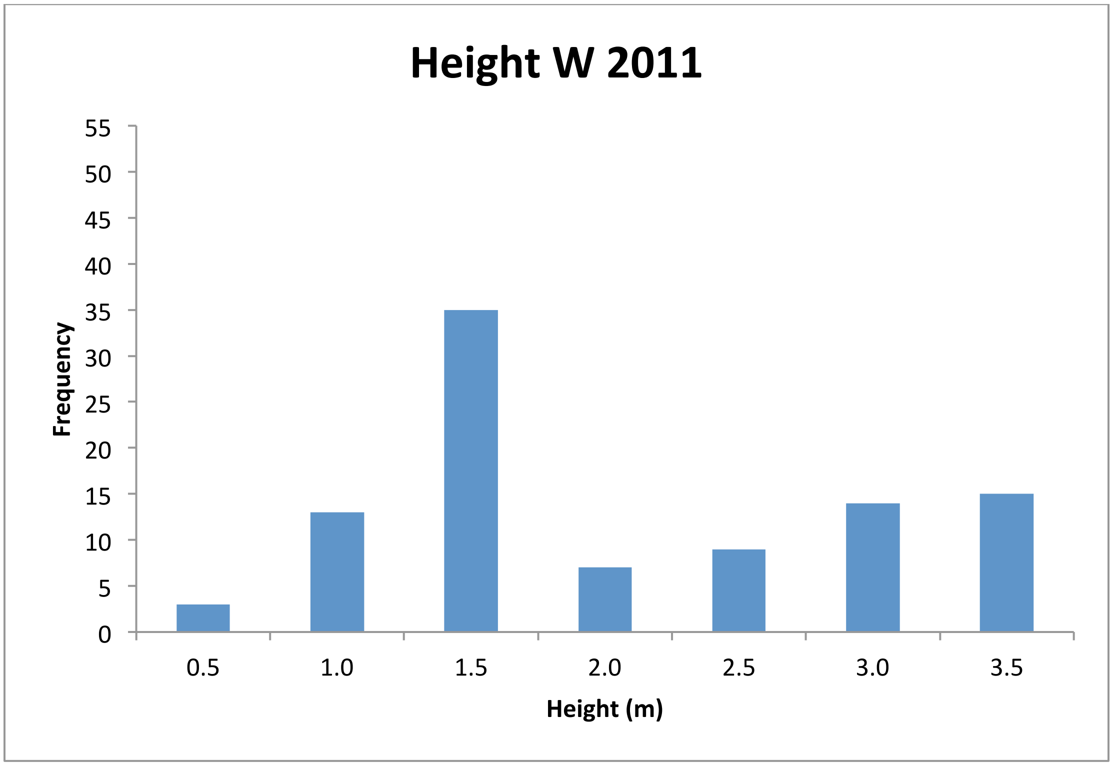

Calorimetry B 2010
14
12
10
8
6
4
2
0
Frequency
4050
4100
4150
4200
4250
4300
4350
4400
4450
4500
Energy Content (col/g)

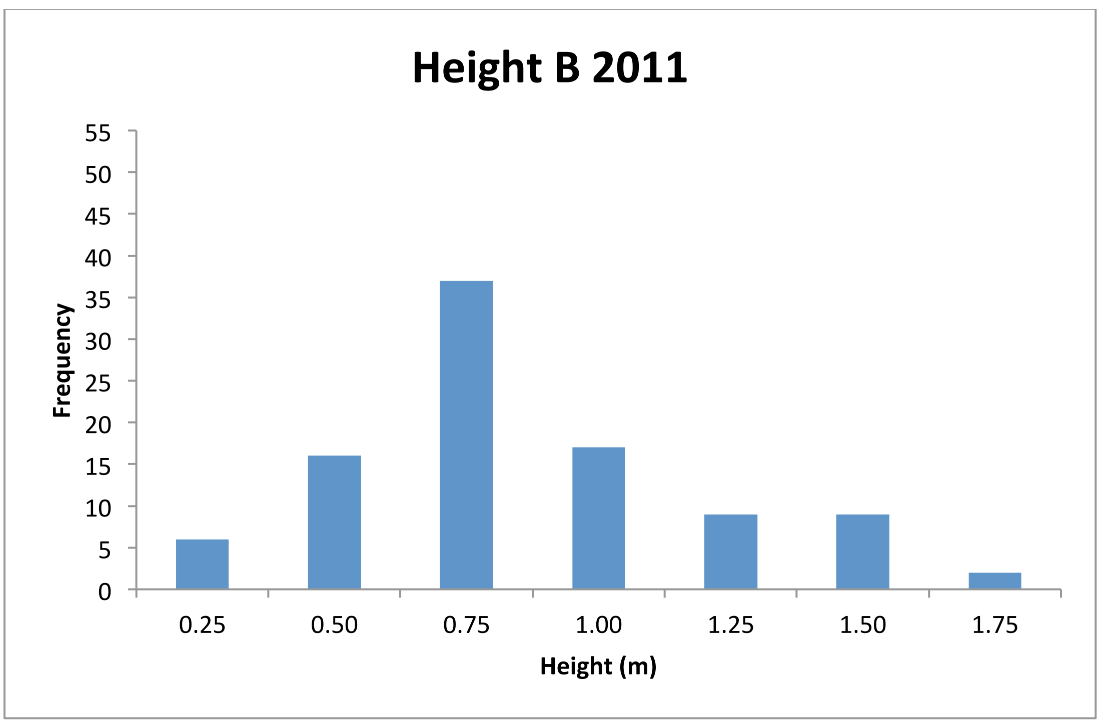

Calorimetry B 2011
Frequency
14
12
10
8
6
4
2
0
4100
4150
4200
4250
4300
4350
4400
Energy Content (cal/g)

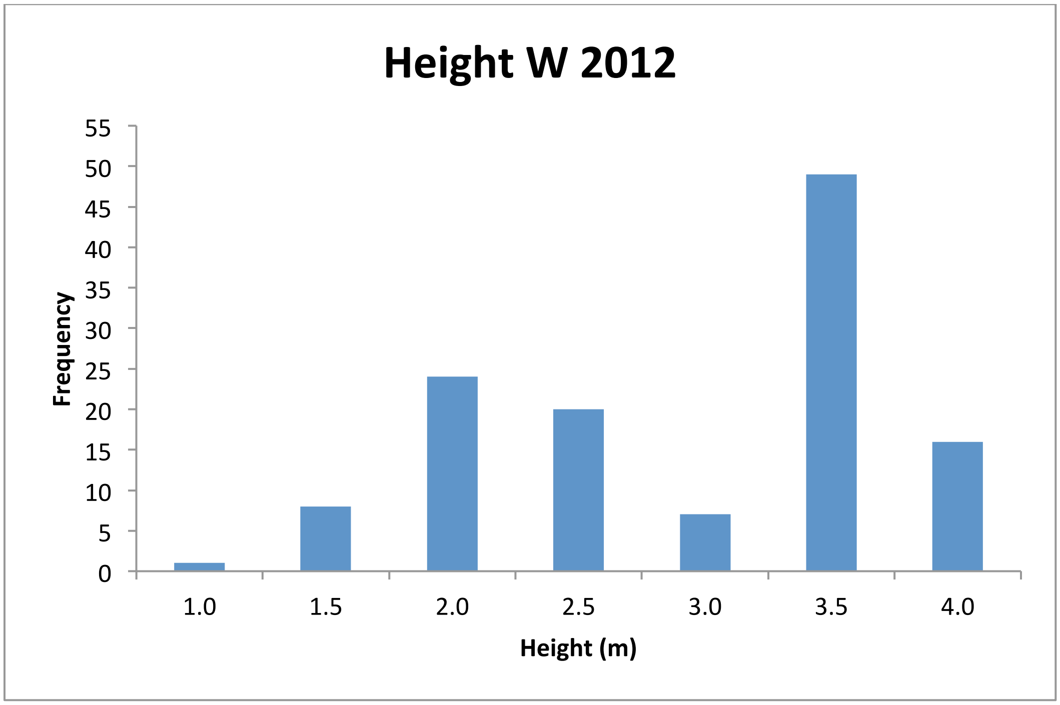

Calorimetry B 2012
Frequency
14
12
10
8
6
4
2
0
4100
4200
4300
4400
4500
4600
4700
4800
Energy Content (cal/g)

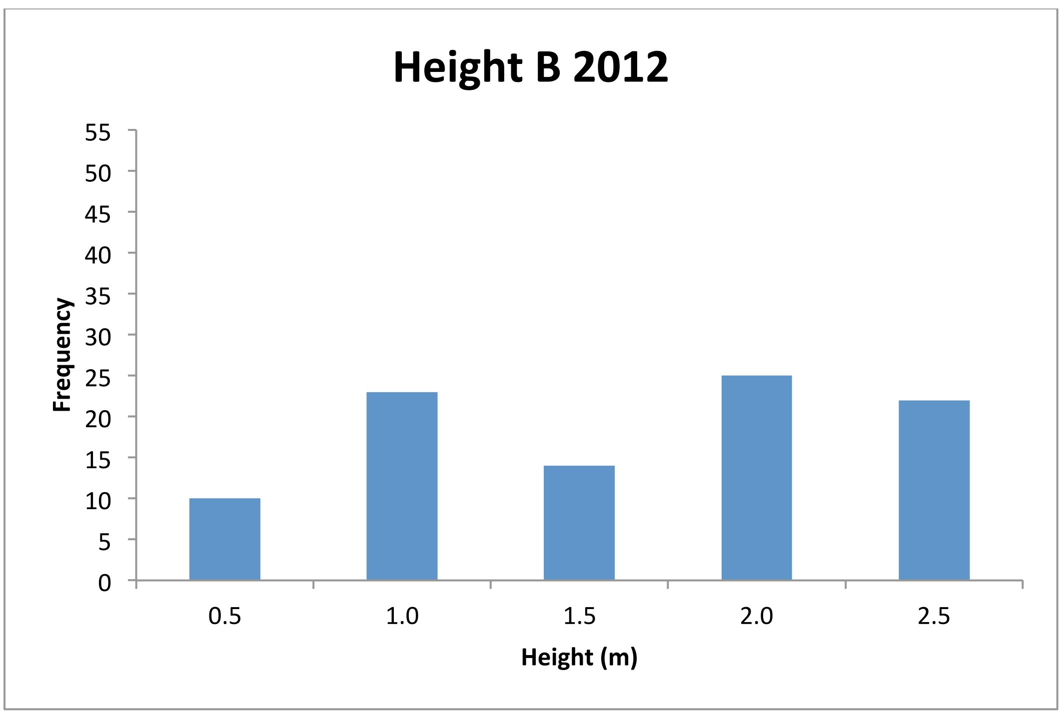

Height W 2010
Frequency
55
50
45
40
35
30
25
20
15
10
5
0
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
Height (m)

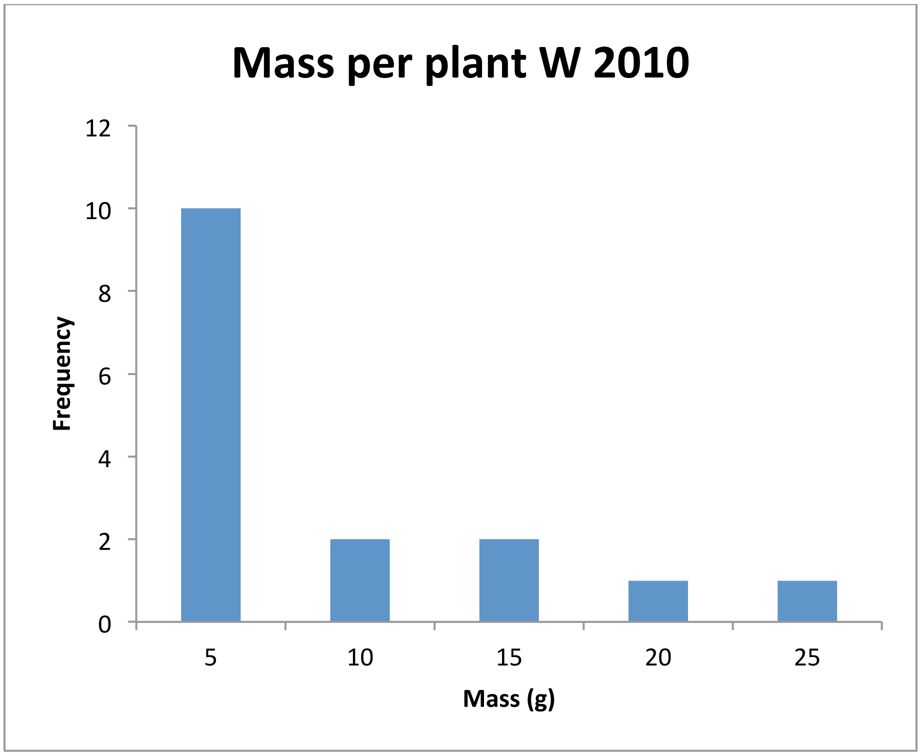

Height B 2010
Frequency
55
50
45
40
35
30
25
20
15
10
5
0
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Height (m)

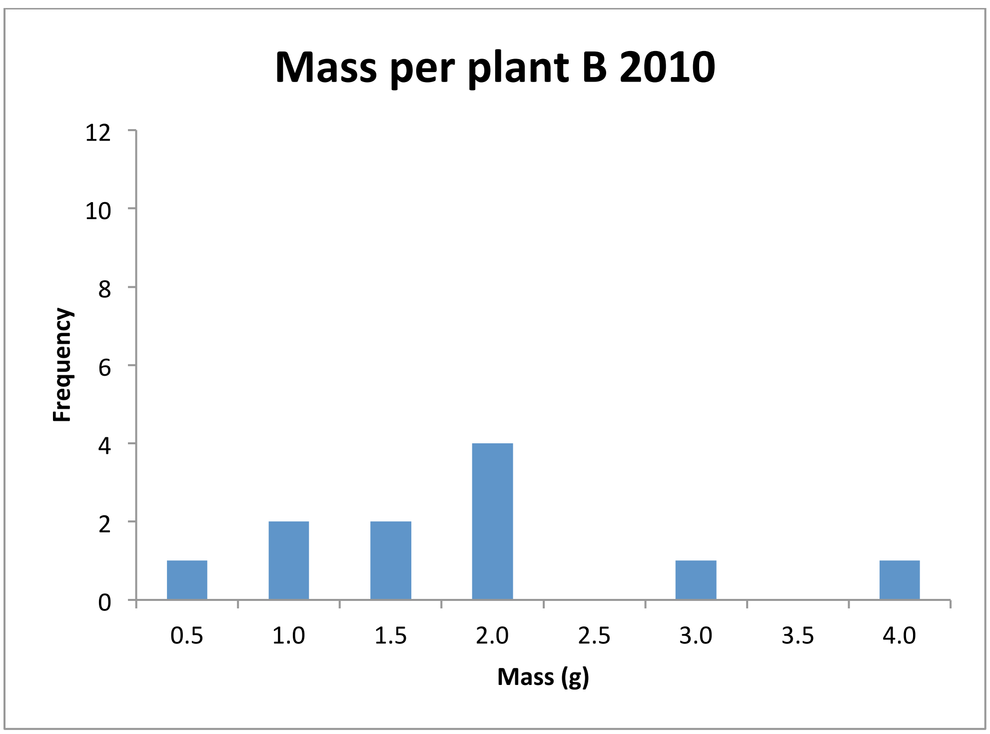

Height W 2011
Frequency
55
50
45
40
35
30
25
20
15
10
5
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
Height (m)

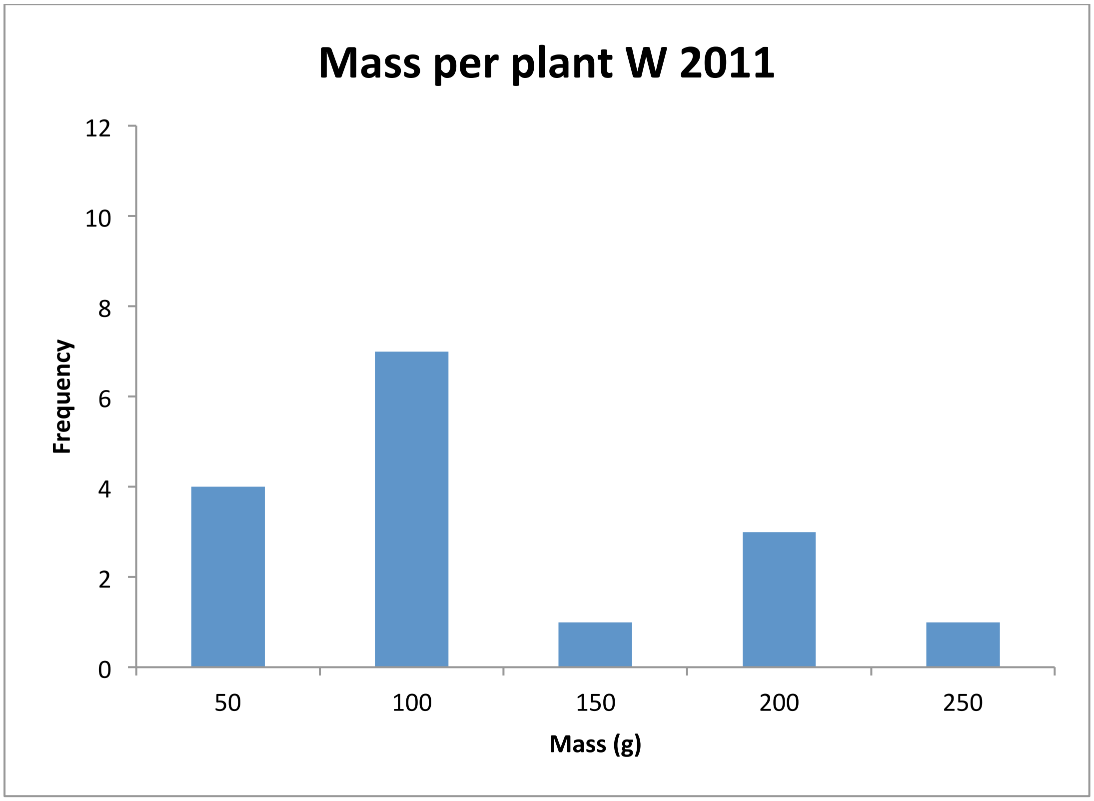

Height B 2011
Frequency
55
50
45
40
35
30
25
20
15
10
5
0
0.25
0.50
0.75
1.00
1.25
1.50
1.75
Height (m)

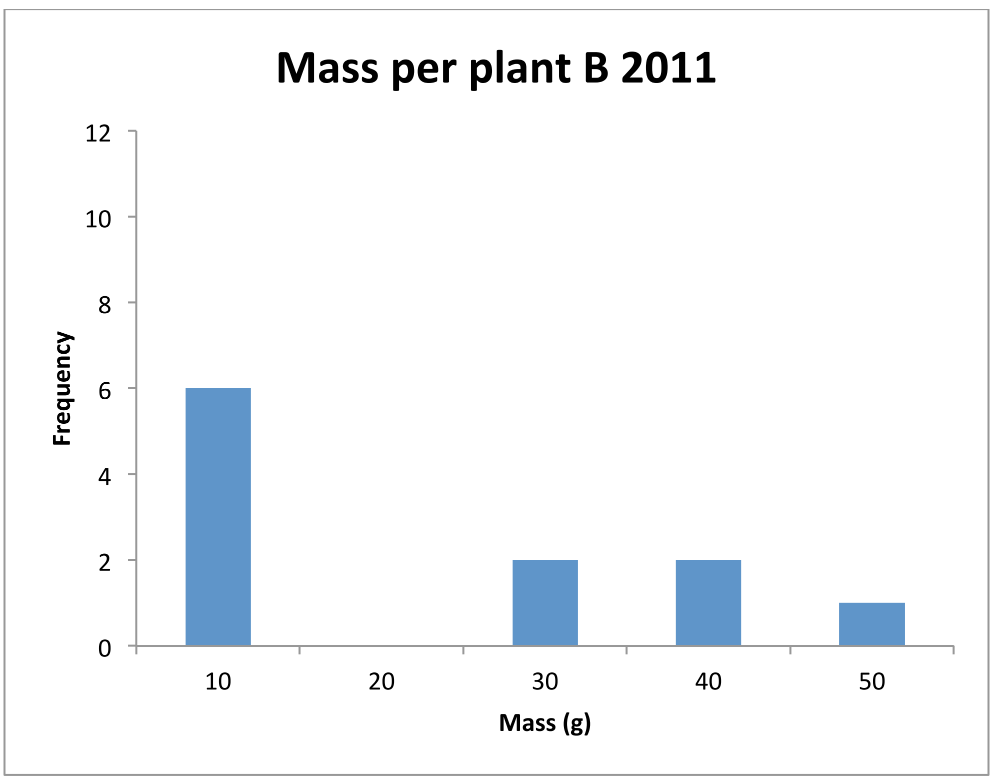

Height W 2012
55
50
45
40
35
30
25
20
15
10
5
0
Frequency
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Height (m)

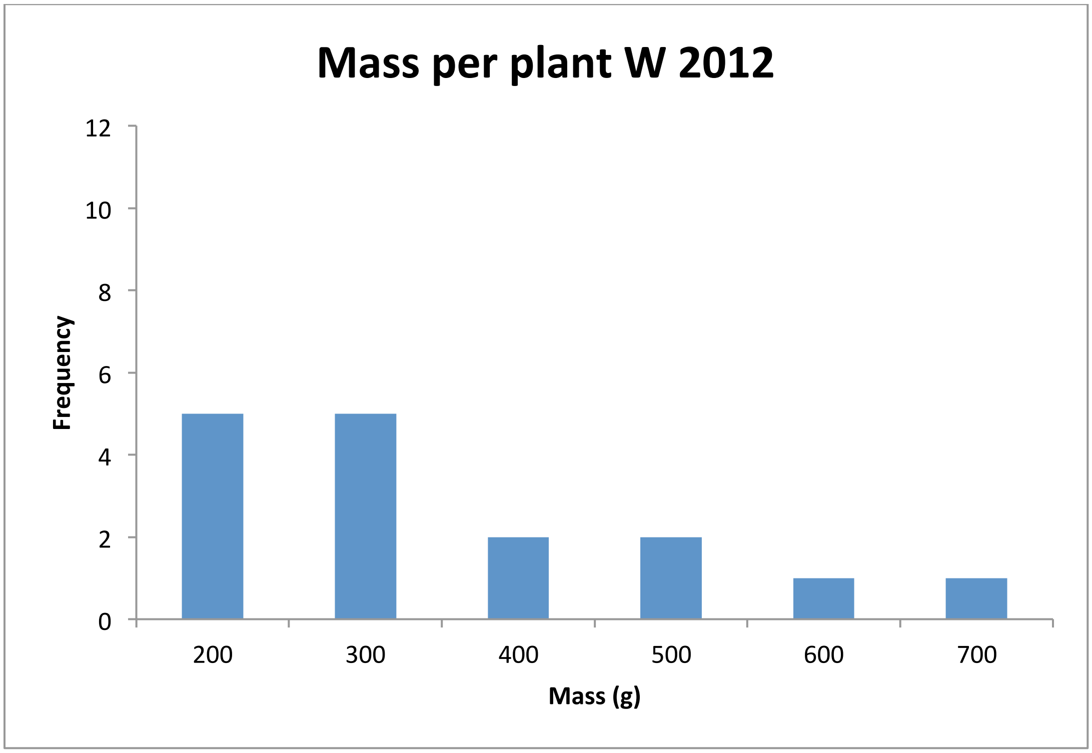

Height B 2012
55
50
45
40
35
30
25
20
15
10
5
0
Frequency
0.5
1.0
1.5
2.0
2.5
Height (m)


Mass per plant W 2010
Frequency
0
2
4
6
8
10
12
5
10
15
20
25
Mass (g)

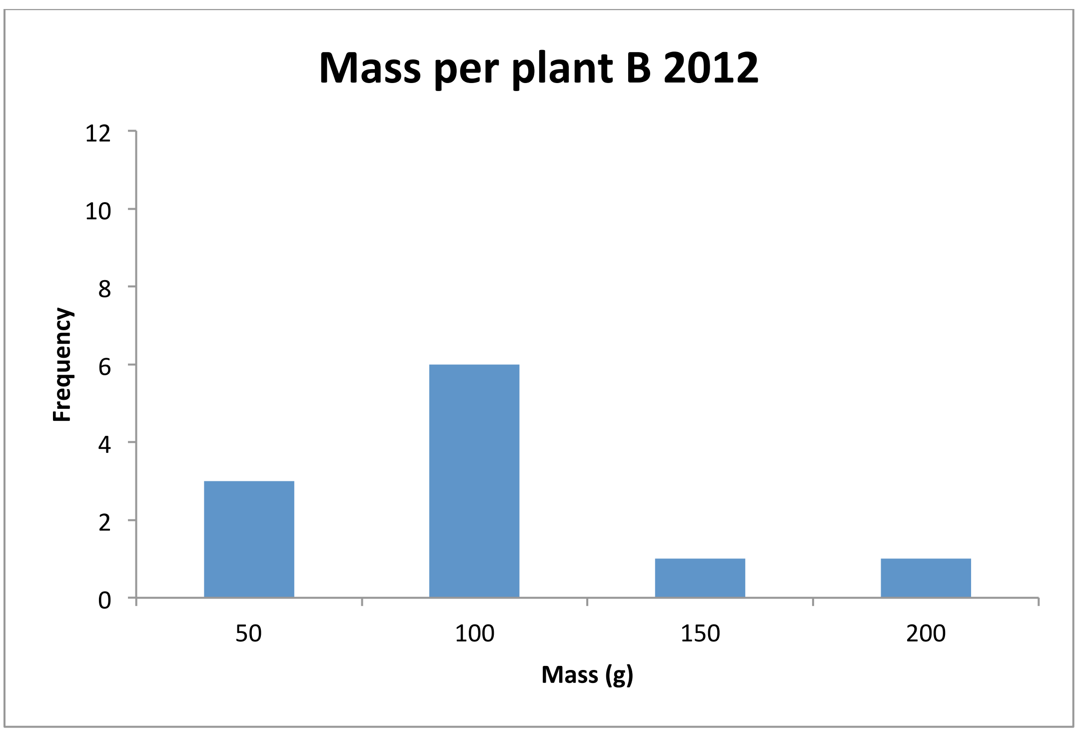

Mass per plant B 2010
Frequency
0
2
4
6
8
10
12
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Mass (g)


Mass per plant W 2011
12
10
8
6
4
2
0
Frequency
50
100
150
200
250
Mass (g)


Mass per plant B 2011
12
10
8
6
4
2
0
Frequency
10
20
30
40
50
Mass (g)



Mass per plant W 2012
Frequency
12
10
8
6
4
2
0
200
300
400
500
600
700
Mass (g)



Mass per plant B 2012
Frequency
12
10
8
6
4
2
0
50
100
150
200
Mass (g)

Appendix B: Economic Analysis Data

Cropland, Average Value per Acre – Region, State, and United States: 2007-2011						
Region and state	**2007**	**2008**	**2009**	**2010**	**2011**	**Region Average**
Northeast	**$ 5,350**	**$ 5,590**	**$ 5,340**	**$ 5,260**	**$ 5,190**	
Delaware	10,200	9,800	8,500	7,900	7,800	
Maryland	8,400	7,800	7,300	7,000	7,000	
New Jersey	16,000	15,600	14,000	13,300	12,800	
New York	1,900	2,150	2,200	2,400	2,400	
Pennsylvania	5,330	6,000	5,700	5,650	5,550	
Other States	7,690	7,930	7,570	7,150	7,040	$ 6,826
Lake	**2,830**	**3,080**	**3,020**	**3,120**	**3,450**	
Michigan	3,280	3,480	3,370	3,300	3,500	
Minnesota	2,420	2,700	2,610	2,820	3,200	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Corn Belt	**3,530**	**4,030**	**3,910**	**4,240**	**4,920**	
Illinois	4,150	4,850	4,670	4,900	5,800	
Indiana	3,640	4,140	3,950	4,400	4,800	4,710
Iowa	3,600	4,260	4,050	4,600	5,700	
Missouri	2,330	2,500	2,540	2,690	2,850	
Ohio	3,820	4,140	3,900	4,050	4,400	$ 4,745
Northern Plains	**1,090**	**1,280**	**1,300**	**1,450**	**1,700**	
Kansas	914	1,020	1,050	1,150	1,300	
Nebraska	1,760	2,050	2,180	2,510	2,960	
North Dakota	670	810	800	870	1,040	
South Dakota	1,180	1,400	1,400	1,560	1,810	$ 1,762
Appalachian	**3,570**	**3,730**	**3,600**	**3,590**	**3,590**	
Kentucky	2,930	3,100	3,150	3,180	3,250	
North Carolina	3,720	3,850	3,770	3,720	3,720	
Tennessee	3,200	3,400	3,270	3,400	3,400	
Virginia	5,250	5,350	5,000	4,700	4,500	
West Virginia	3,600	3,800	3,500	3,400	3,500	$ 3,660
Yearly National Average	$ 4,133	$ 4,337	$ 4,118	$ 4,141	$ 4,326	

Consumer Price Estimates for Energy by Source

Prices ($ per Million BTU)

	Primary Energy		Petroleum									Descriptive Statistics					
Year	Coal	Natural Gas	Distillate Fuel Oil	Jet Fuel	LPG	Motor Gasoline	Residential Fuel Oil	Nuclear Fuel	Biomass	Electric Power	Retail Electricity	High	75th Percentile	Median	Average	25th Percentile	Low
1970	$ 0.38	$ 0.59	$ 1.16	$ 0.73	$ 1.43	$ 2.85	$ 0.42	$ 0.18	$ 1.29	$ 0.32	$ 4.98	$ 4.98	$ 1.36	$ 0.73	$ 1.30	$ 0.40	$ 0.18
1971	0.42	0.63	1.22	0.77	1.46	2.90	0.58	0.18	1.31	0.38	5.30	5.30	1.39	0.77	1.38	0.50	0.18
1972	0.45	0.68	1.22	0.79	1.49	2.88	0.62	0.18	1.33	0.42	5.54	5.54	1.41	0.79	1.42	0.54	0.18
1973	0.48	0.73	1.46	0.92	1.97	3.10	0.75	0.19	1.39	0.47	5.86	5.86	1.72	0.92	1.57	0.61	0.19
1974	0.88	0.89	2.44	1.58	2.77	4.32	1.82	0.20	1.50	0.87	7.42	7.42	2.61	1.58	2.24	0.89	0.20
1975	1.03	1.18	2.60	2.05	2.93	4.65	1.93	0.24	1.50	0.97	8.61	8.61	2.77	1.93	2.52	1.11	0.24
1976	1.04	1.46	2.77	2.25	3.16	4.84	1.90	0.25	1.53	1.03	9.13	9.13	2.97	1.90	2.67	1.25	0.25
1977	1.11	1.76	3.11	2.59	3.61	5.13	2.14	0.27	1.58	1.17	10.11	10.11	3.36	2.14	2.96	1.38	0.27
1978	1.27	1.95	3.26	2.87	3.56	5.24	2.08	0.30	1.61	1.27	10.92	10.92	3.41	2.08	3.12	1.44	0.30
1979	1.36	2.31	4.69	3.90	4.46	7.11	2.83	0.34	1.88	1.50	11.78	11.78	4.58	2.83	3.83	1.69	0.34
1980	1.46	2.86	6.70	6.36	5.59	9.84	3.88	0.43	2.26	1.77	13.95	13.95	6.53	3.88	5.01	2.02	0.43
1981	1.64	3.43	8.03	7.57	6.13	10.94	4.91	0.48	2.52	2.04	16.14	16.14	7.80	4.91	5.80	2.28	0.48
1982	1.73	4.23	7.78	7.23	6.60	10.39	4.65	0.54	2.60	2.05	18.16	18.16	7.51	4.65	6.00	2.33	0.54
1983	1.70	4.72	7.32	6.53	7.11	9.12	4.50	0.58	2.44	2.02	18.62	18.62	7.22	4.72	5.88	2.23	0.58
1984	1.71	4.75	7.37	6.25	6.88	8.89	4.75	0.67	2.53	2.02	18.50	18.50	7.13	4.75	5.85	2.28	0.67
1985	1.69	4.61	7.22	5.91	6.55	9.01	4.30	0.71	2.47	1.91	19.05	19.05	6.89	4.61	5.77	2.19	0.71
1986	1.62	4.07	5.68	3.92	6.43	6.79	2.37	0.70	2.12	1.60	19.05	19.05	6.06	3.92	4.94	1.87	0.70
1987	1.53	3.77	5.97	4.03	6.05	7.23	2.86	0.71	2.07	1.57	18.74	18.74	6.01	3.77	4.96	1.82	0.71
1988	1.50	3.78	5.83	3.80	5.86	7.33	2.35	0.73	2.09	1.49	18.68	18.68	5.85	3.78	4.86	1.80	0.73
1989	1.48	3.82	6.43	4.39	5.51	8.02	2.72	0.70	1.42	1.51	18.98	18.98	5.97	3.82	5.00	1.50	0.70
1990	1.49	3.82	7.68	5.68	6.72	9.12	3.17	0.67	1.32	1.48	19.32	19.32	7.20	3.82	5.50	1.49	0.67
1991	1.48	3.74	7.29	4.83	6.77	8.93	2.62	0.63	1.39	1.40	19.84	19.84	7.03	3.74	5.36	1.44	0.63
1992	1.45	3.83	7.09	4.52	6.16	8.96	2.28	0.59	1.32	1.38	20.06	20.06	6.63	3.83	5.24	1.42	0.59
1993	1.42	4.10	7.08	4.29	6.17	8.83	2.26	0.56	1.28	1.40	20.38	20.38	6.63	4.10	5.25	1.41	0.56
1994	1.39	4.08	6.99	3.95	6.61	8.96	2.32	0.56	1.39	1.36	20.33	20.33	6.80	3.95	5.27	1.39	0.56
1995	1.37	3.73	6.98	4.00	6.51	9.22	2.46	0.54	1.40	1.29	20.29	20.29	6.75	3.73	5.25	1.39	0.54
1996	1.33	4.25	7.87	4.82	7.98	9.85	2.80	0.51	1.25	1.35	20.16	20.16	7.93	4.25	5.65	1.34	0.51
1997	1.32	4.53	7.66	4.53	7.39	9.81	2.93	0.51	1.15	1.38	20.13	20.13	7.53	4.53	5.58	1.35	0.51
1998	1.29	4.13	6.57	3.35	5.95	8.45	2.15	0.50	1.27	1.32	19.80	19.80	6.26	3.35	4.98	1.31	0.50
1999	1.27	4.16	7.19	4.01	6.60	9.31	2.51	0.48	1.34	1.33	19.52	19.52	6.90	4.01	5.25	1.34	0.48
2000	1.24	5.62	9.86	6.64	9.55	11.89	4.32	0.46	1.58	1.71	20.03	20.03	9.71	5.62	6.63	1.65	0.46
2001	1.29	6.87	9.18	5.72	9.54	11.34	3.99	0.44	2.08	1.85	21.41	21.41	9.36	5.72	6.70	1.97	0.44
2002	1.30	5.31	8.64	5.33	8.09	10.69	3.91	0.43	2.19	1.54	21.15	21.15	8.37	5.31	6.23	1.87	0.43
2003	1.32	7.08	10.05	6.46	10.32	12.34	4.75	0.42	1.98	1.84	21.85	21.85	10.19	6.46	7.13	1.91	0.42
2004	1.41	7.91	12.23	8.93	12.24	14.67	4.92	0.42	2.17	2.00	22.38	22.38	12.24	7.91	8.12	2.09	0.42
2005	1.62	9.92	16.41	12.86	14.58	17.89	6.65	0.43	3.10	2.61	23.92	23.92	15.50	9.92	10.00	2.86	0.43
2006	1.78	9.62	18.55	14.80	16.85	20.27	7.93	0.44	3.15	2.48	26.15	26.15	17.70	9.62	11.09	2.82	0.44
2007	1.88	9.31	19.87	16.01	18.76	22.01	8.57	0.46	3.36	2.68	26.84	26.84	19.32	9.31	11.80	3.02	0.46
2008	2.21	10.83	26.33	22.56	23.35	25.53	12.64	0.47	3.71	3.21	28.64	28.64	24.44	12.64	14.50	3.46	0.47
2009	2.33	7.66	16.98	12.61	16.38	18.51	9.69	0.55	3.30	2.44	28.90	28.90	16.68	9.69	10.85	2.87	0.55
High	**$ 2.33**	**$ 10.83**	**$ 26.33**	**$ 22.56**	**$ 23.35**	**$ 25.53**	**$ 12.64**	**$ 0.73**	**$ 3.71**	**$ 3.21**	**$ 28.90**						
75th Percentile	**1.62**	**4.89**	**8.18**	**6.48**	**8.01**	**10.75**	**4.54**	**0.57**	**2.31**	**1.93**	**20.34**						
Median	**1.40**	**4.08**	**7.14**	**4.53**	**6.53**	**8.99**	**2.82**	**0.48**	**1.60**	**1.50**	**19.19**						
Average	**1.37**	**4.32**	**7.82**	**5.76**	**7.40**	**9.68**	**3.63**	**0.47**	**1.93**	**1.56**	**17.52**						
25th Percentile	**1.27**	**2.72**	**5.43**	**3.69**	**5.25**	**7.03**	**2.23**	**0.40**	**1.38**	**1.31**	**13.41**						
Min	**0.38**	**0.59**	**1.16**	**0.73**	**1.43**	**2.85**	**0.42**	**0.18**	**1.15**	**0.32**	**4.98**						1.7937E+10

Illustrative Miscanthus Sales Price

Illustrative $ / M. BTU	$ 0.50	$ 1.00	$ 1.50	$ 1.60	$ 1.93	$ 2.50	$ 3.00	$ 3.50	$ 5.00	$ 10.00	$ 15.00
M. BTU / Ton	16.01	16.01	16.01	16.01	16.01	16.01	16.01	16.01	16.01	16.01	16.01
$ / Ton	$ 8.00	$ 16.01	$ 24.01	$ 25.61	$ 30.89	$ 40.02	$ 48.02	$ 56.02	$ 80.03	$ 160.07	$ 240.10

Processing Equipment Depreciation Schedule

Item	Purchase Price	Installation	Useful Life	Annual Depreciation
Dryer	$ 350,000	$ 71,000	$ 15	$ 28,067
Pellet Mill	315,000	71,000	15	25,733
Pellet Cooler	32,000	24,000	15	3,733
Miscellaneous Equipment	100,000	-	15	6,667
Annual Depreciation				$ 64,200

Processing Cost Schedule ($ / Ton)

Drying	$ 7.84
Pelletizing	2.09
Packaging	1.37

Tons Produced

Year 1	9.66
Year 2	110.64
Year 3	328.20

Transportation Equipment Depreciation Schedule

Item	Purchase Price	Useful Life	Annual Depreciation
Loader	$ 82,000	$ 15	$ 5,467
Truck	100,000	15	6,667
Total			**$ 12,133**

Harvesting and Planting Equipment Depreciation Schedule

Item	Purchase Price	Useful Life	Annual Depreciation
Forage Harvester	$ 29,000	15	$ 1,933.33
Potato Planter	86,000	15	5,733.33
Tractor	150,000	15	10,000.00
Total			**$ 17,666.67**

Facility Information

	Hectares	Acres
Average MD Farm	64.75	160
MD Price Per Acre		$ 7,000
Land Purchase Price		$ 1,120,000
Marginal Land Price Per Acre		$ 1,762
Land Acquisition Price		$ 281,920
Price Per Miscanthus Rhizome		$ 2.25
Acres Per Hectare		2.4710538

Transportation Fixed Costs

Registration, Permits & Fees	$ 6,970
Insurance (Vehicle)	3,290
Insurance (Goods-in-Transit)	500
Insurance (Personal Sickness)	450
Insurance (Public Liability)	405
Insurance (Workers' Comp)	1,533
Total	**$ 13,148**

Transportation Variable Costs Per Mile

Fuel (3.872 Per Gallon)	$ 0.55
Tires	0.03
Servicing & Maintenance	0.12
Total	**$ 0.70**

Assumptions

Land Price (%)	100.0%
Subsidy Amount	0.0%
Equipment Purchased	100.0%
Equipment Owned	0.0%
Choose	8
Miscanthus Price	$ 56.02

Scenario One Revenue & Worst Case Expenses

GEMSTONE TEAM BIOFUELS

Illustrative Maryland Commercial Miscanthus Production Income Statement (Agriculturally Viable Land)

	Actual			Estimated	Projected											
Fiscal	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Projection N**
Revenue																
Miscanthus x. Giganteus Sales	$ 541	$ 6,198	$ 18,387	$ 22,064	$ 23,167	$ 24,325	$ 25,542	$ 26,819	$ 28,160	$ 29,568	$ 31,046	$ 32,598	$ 34,228	$ 35,940	$ 37,737	
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Revenue fron
Total Revenue	**$ 541**	**$ 6,198**	**$ 18,387**	**$ 22,064**	**$ 23,167**	**$ 24,325**	**$ 25,542**	**$ 26,819**	**$ 28,160**	**$ 29,568**	**$ 31,046**	**$ 32,598**	**$ 34,228**	**$ 35,940**	**$ 37,737**	
Cost of Production																
Harvesting & Planting	(123)	(1,410)	(4,181)	(5,017)	(5,268)	(5,532)	(5,808)	(6,099)	(6,404)	(6,724)	(7,060)	(7,413)	(7,784)	(8,173)	(8,582)	$12.74
Cost of Plants	(27,225)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Includes Dryi
Processing	(109)	(1,250)	(3,709)	(4,450)	(4,673)	(4,883)	(5,078)	(5,256)	(5,414)	(5,549)	(5,660)	(5,745)	(5,803)	(5,832)	(5,832)	
Transportation	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	Constant
Gross Profit	(40,767)	(10,313)	(3,354)	(1,255)	(625)	60	804	1,613	2,491	3,444	4,475	5,589	6,791	8,084	9,473	
Operating, SG&A Expenses																
Depreciation (Harvest & Planting Equipment)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	Straight line
Depreciation (Processing Equipment)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	Straight line
Depreciation (Transportation Equipment)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	Straight line
Amortization (Land)	(12,749)	(13,428)	(14,144)	(14,897)	(15,690)	(16,526)	(17,406)	(18,333)	(19,309)	(20,338)	(21,421)	(22,562)	(23,763)	(25,029)	(26,362)	See amortiza
Operating Income	**$ (147,516)**	**$ (117,741)**	**$ (111,498)**	**$ (110,152)**	**$ (110,315)**	**$ (110,466)**	**$ (110,602)**	**$ (110,720)**	**$ (110,818)**	**$ (110,894)**	**$ (110,946)**	**$ (110,972)**	**$ (110,972)**	**$ (110,945)**	**$ (110,889)**	
Interest Expense (Land)	(46,291)	(45,612)	(44,897)	(44,144)	(43,350)	(42,515)	(41,634)	(40,707)	(39,731)	(38,703)	(36,479)	(36,479)	(35,277)	(34,012)	(32,679)	
Pre-Tax Income	**$ (193,807)**	**$ (163,353)**	**$ (156,395)**	**$ (154,295)**	**$ (153,666)**	**$ (152,981)**	**$ (152,237)**	**$ (151,428)**	**$ (150,549)**	**$ (149,597)**	**$ (147,425)**	**$ (147,451)**	**$ (146,249)**	**$ (144,956)**	**$ (143,568)**	
Income Taxes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Net Income	**$ (193,807)**	**$ (163,353)**	**$ (156,395)**	**$ (154,295)**	**$ (153,666)**	**$ (152,981)**	**$ (152,237)**	**$ (151,428)**	**$ (150,549)**	**$ (149,597)**	**$ (147,425)**	**$ (147,451)**	**$ (146,249)**	**$ (144,956)**	**$ (143,568)**	
Revenue Growth Rate		1,045.1%	196.6%	20.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	Constant
Harvesting & Planting Cost Growth Rate		1,045.1%	196.6%	20.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	Decrease by
Processing Cost Growth Rate		1,045.1%	196.6%	20.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	Decrease by

Illustrative Maryland Commercial Miscanthus Production Cash Flow Statement (Agriculturally Viable Land)

	Actual			Estimated	Projected											
Fiscal	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Projection N**
Net Income	$ (193,807)	$ (163,353)	$ (156,395)	$ (154,295)	$ (153,666)	$ (152,981)	$ (152,237)	$ (151,428)	$ (150,549)	$ (149,597)	$ (147,425)	$ (147,451)	$ (146,249)	$ (144,956)	$ (143,568)	
Cash Flow From Operating Activities																
Depreciation (Harvest & Planting Equipment)	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	
Depreciation (Processing Equipment)	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	
Depreciation (Transportation Equipment)	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	
Amortization (Land)	12,749	13,428	14,144	14,897	15,690	16,526	17,406	18,333	19,309	20,338	21,421	22,562	23,763	25,029	26,362	
Change in Working Capital	(27,225)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Operating Activities	**$ 79,524**	**$ 107,428**	**$ 108,144**	**$ 108,897**	**$ 109,690**	**$ 110,526**	**$ 111,406**	**$ 112,333**	**$ 113,309**	**$ 114,338**	**$ 115,421**	**$ 116,562**	**$ 117,763**	**$ 119,029**	**$ 120,362**	
Cash Flow From Investing Activities																
Harvesting & Planting Equipment	(265,000)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Processing Equipment	(797,000)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Land Acquisition	(1,120,000)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Transportation Equipment	(182,000)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Investing Activities	**$ (2,364,000)**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Cash Flow from Financing Activities																
Mortgage Loan	896,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash flow from Financing Activities	**$ 896,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Net Change in Cash	**$ (1,582,283)**	**$ (55,925)**	**$ (48,251)**	**$ (45,399)**	**$ (43,975)**	**$ (42,455)**	**$ (40,831)**	**$ (39,095)**	**$ (37,240)**	**$ (35,259)**	**$ (32,004)**	**$ (30,890)**	**$ (28,486)**	**$ (25,927)**	**$ (23,206)**	

GEMSTONE TEAM BIOFUELS

Illustrative Maryland Commercial Miscanthus Production Income Statement (Agriculturally Marginal Land)

	Actual			Estimated	Projected											
Fiscal	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Projection N**
Revenue																
Miscanthus x. Giganteus Sales	$ 73.42	$ 983.18	$ 5,895.57	$ 7,074.68	$ 7,428.42	$ 7,799.84	$ 8,189.83	$ 8,599.32	$ 9,029.29	$ 9,480.75	$ 9,954.79	$ 10,452.53	$ 10,975.16	$ 11,523.91	$ 12,100.11	
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Revenue fron
Total Revenue	**$ 73.42**	**$ 983.18**	**$ 5,895.57**	**$ 7,074.68**	**$ 7,428.42**	**$ 7,799.84**	**$ 8,189.83**	**$ 8,599.32**	**$ 9,029.29**	**$ 9,480.75**	**$ 9,954.79**	**$ 10,452.53**	**$ 10,975.16**	**$ 11,523.91**	**$ 12,100.11**	
Cost of Production																
Harvesting & Planting	(123)	(1,410)	(4,181)	(5,017)	(5,268)	(5,532)	(5,808)	(6,099)	(6,404)	(6,724)	(7,060)	(7,413)	(7,784)	(8,173)	(8,582)	$12.74
Cost of Plants	(27,225)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Includes Dryi
Processing	(109)	(1,250)	(3,709)	(4,450)	(4,673)	(4,883)	(5,078)	(5,256)	(5,414)	(5,549)	(5,660)	(5,745)	(5,803)	(5,832)	(5,832)	
Transportation	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	Constant
Gross Profit	(41,235)	(15,528)	(15,845)	(16,244)	(16,364)	(16,466)	(16,548)	(16,607)	(16,639)	(16,643)	(16,617)	(16,557)	(16,462)	(16,332)	(16,164)	
Operating, SG&A Expenses																
Depreciation (Harvest & Planting Equipment)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	Straight line
Depreciation (Processing Equipment)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	Straight line
Depreciation (Transportation Equipment)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	Straight line
Amortization (Land)	(3,209)	(3,380)	(3,560)	(3,750)	(3,949)	(4,160)	(4,381)	(4,615)	(4,860)	(5,119)	(5,392)	(5,679)	(5,982)	(6,300)	(6,636)	See amortiz
Operating Income	**$ (138,444)**	**$ (112,908)**	**$ (113,405)**	**$ (113,994)**	**$ (114,313)**	**$ (114,626)**	**$ (114,929)**	**$ (115,221)**	**$ (115,500)**	**$ (115,763)**	**$ (116,008)**	**$ (116,236)**	**$ (116,444)**	**$ (116,632)**	**$ (116,800)**	
Interest Expense (Land)	(11,652)	(11,481)	(11,301)	(11,112)	(10,912)	(10,702)	(10,480)	(10,247)	(10,001)	(9,742)	(9,469)	(9,182)	(8,880)	(8,561)	(8,226)	
Pre-Tax Income	**$ (150,096)**	**$ (124,389)**	**$ (124,707)**	**$ (125,105)**	**$ (125,225)**	**$ (125,327)**	**$ (125,409)**	**$ (125,468)**	**$ (125,501)**	**$ (125,505)**	**$ (125,478)**	**$ (125,418)**	**$ (125,324)**	**$ (125,193)**	**$ (125,025)**	
Income Taxes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Net Income	**$ (150,096)**	**$ (124,389)**	**$ (124,707)**	**$ (125,105)**	**$ (125,225)**	**$ (125,327)**	**$ (125,409)**	**$ (125,468)**	**$ (125,501)**	**$ (125,505)**	**$ (125,478)**	**$ (125,418)**	**$ (125,324)**	**$ (125,193)**	**$ (125,025)**	
Revenue Growth Rate		1,239.1%	499.6%	20.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	Constant
Harvesting & Planting Cost Growth Rate		1,045.1%	196.6%	20.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	Decrease by
Processing Cost Growth Rate		1,045.1%	196.6%	20.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	Decrease by

Illustrative Maryland Commercial Miscanthus Production Cash Flow Statement (Agriculturally Marginal Land)

	Actual			Estimated	Projected											
Fiscal	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Projection N**
Net Income	$ (150,096)	$ (124,389)	$ (124,707)	$ (125,105)	$ (125,225)	$ (125,327)	$ (125,409)	$ (125,468)	$ (125,501)	$ (125,505)	$ (125,478)	$ (125,418)	$ (125,324)	$ (125,193)	$ (125,025)	
Cash Flow From Operating Activities																
Depreciation (Harvest & Planting Equipment)	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	
Depreciation (Processing Equipment)	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	
Depreciation (Transportation Equipment)	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	
Amortization (Land)	3,209	3,380	3,560	3,750	3,949	4,160	4,381	4,615	4,860	5,119	5,392	5,679	5,982	6,300	6,636	
Change in Working Capital	(27,225.00)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Operating Activities	**$ 69,984.21**	**$ 97,380.12**	**$ 97,560.14**	**$ 97,749.75**	**$ 97,949.45**	**$ 98,159.78**	**$ 98,381.32**	**$ 98,614.66**	**$ 98,860.43**	**$ 99,119.28**	**$ 99,391.92**	**$ 99,679.08**	**$ 99,981.53**	**$ 100,300.09**	**$ 100,635.62**	
Cash Flow From Investing Activities																
Harvesting & Planting Equipment	$ (265,000)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
Processing Equipment	(797,000)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Land Acquisition	(281,920)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Transportation Equipment	(182,000)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Investing Activities	**$ (1,525,920)**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Cash Flow from Financing Activities																
Mortgage Loan	$ 225,536	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
Cash Flow From Investing Activities	**$ 225,536**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Net Change in Cash	**$ (1,380,496)**	**$ (27,009)**	**$ (27,146)**	**$ (27,356)**	**$ (27,276)**	**$ (27,168)**	**$ (27,028)**	**$ (26,853)**	**$ (26,640)**	**$ (26,385)**	**$ (26,086)**	**$ (25,739)**	**$ (25,342)**	**$ (24,893)**	**$ (24,390)**	

Scenario One Revenue & Base Case Expenses

Processing Equipment Depreciation Schedule

Item	Purchase Price	Installation	Useful Life	Annual Depreciation
Dryer	$ 175,000	$ 71,000	$ 15	$ 16,400
Pellet Mill	157,500	71,000	15	15,233
Pellet Cooler	16,000	24,000	15	2,667
Miscellaneous Equipment	50,000	-	15	3,333
Annual Depreciation				$ 37,633

Processing Cost Schedule ($ / Ton)

Drying	$ 7.84
Pelletizing	2.09
Packaging	1.37

Tons Produced

Year 1	9.66
Year 2	110.64
Year 3	328.20

Transportation Equipment Depreciation Schedule

Item	Purchase Price	Useful Life	Annual Depreciation
Loader	$ 41,000	$ 15	$ 2,733
Truck	50,000	15	3,333
Total			**$ 6,067**

Harvesting and Planting Equipment Depreciation Schedule

Item	Purchase Price	Useful Life	Annual Depreciation
Forage Harvester	$ 14,500	15	$ 966.67
Potato Planter	43,000	15	2,866.67
Tractor	75,000	15	5,000.00
Total			**$ 8,833.33**

Facility Information

	Hectares	Acres
Average MD Farm	64.75	160
MD Price Per Acre		$ 3,500
Land Purchase Price		$ 560,000
Marginal Land Price Per Acre		$ 881
Land Acquisition Price		$ 140,960
Price Per Miscanthus Rhizome		$ 2.25
Acres Per Hectare		2.4710538

Transportation Fixed Costs

Registration, Permits & Fees	$ 6,970
Insurance (Vehicle)	3,290
Insurance (Goods-in-Transit)	500
Insurance (Personal Sickness)	450
Insurance (Public Liability)	405
Insurance (Workers' Comp)	1,533
Total	**$ 13,148**

Transportation Variable Costs Per Mile

Fuel (3.872 Per Gallon)	$ 0.55
Tires	0.03
Servicing & Maintenance	0.12
Total	**$ 0.70**

Assumptions

Land Price (%)	**50.0%**
Subsidy Amount	50.0%
Equipment Purchased	**50.0%**
Equipment Owned	50.0%
Choose	**8**
Miscanthus Price	$ 56.02

GEMSTONE TEAM BIOFUELS

Illustrative Maryland Commercial Miscanthus Production Income Statement (Agriculturally Viable Land)

	Actual			Estimated	Projected											
Fiscal	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Projection N**
Revenue																
Miscanthus x. Giganteus Sales	$ 541	$ 6,198	$ 18,387	$ 22,064	$ 23,167	$ 24,325	$ 25,542	$ 26,819	$ 28,160	$ 29,568	$ 31,046	$ 32,598	$ 34,228	$ 35,940	$ 37,737	
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Revenue fron
Total Revenue	**$ 541**	**$ 6,198**	**$ 18,387**	**$ 22,064**	**$ 23,167**	**$ 24,325**	**$ 25,542**	**$ 26,819**	**$ 28,160**	**$ 29,568**	**$ 31,046**	**$ 32,598**	**$ 34,228**	**$ 35,940**	**$ 37,737**	
Cost of Production																
Harvesting & Planting	(123)	(1,410)	(4,181)	(5,017)	(5,268)	(5,532)	(5,808)	(6,099)	(6,404)	(6,724)	(7,060)	(7,413)	(7,784)	(8,173)	(8,582)	$12.74
Cost of Plants	(27,225)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Includes Dryi
Processing	(109)	(1,250)	(3,709)	(4,450)	(4,673)	(4,883)	(5,078)	(5,256)	(5,414)	(5,549)	(5,660)	(5,745)	(5,803)	(5,832)	(5,832)	
Transportation	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	Constant
Gross Profit	(40,767)	(10,313)	(3,354)	(1,255)	(625)	60	804	1,613	2,491	3,444	4,475	5,589	6,791	8,084	9,473	
Operating, SG&A Expenses																
Depreciation (Harvest & Planting Equipment)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	Straight line
Depreciation (Processing Equipment)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	Straight line
Depreciation (Transportation Equipment)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	Straight line
Amortization (Land)	(6,375)	(6,714)	(7,072)	(7,448)	(7,845)	(8,263)	(8,703)	(9,166)	(9,655)	(10,169)	(10,710)	(11,281)	(11,882)	(12,514)	(13,181)	See amortiza
Operating Income	**$ (141,142)**	**$ (111,027)**	**$ (104,426)**	**$ (102,703)**	**$ (102,470)**	**$ (102,203)**	**$ (101,899)**	**$ (101,554)**	**$ (101,164)**	**$ (100,725)**	**$ (100,236)**	**$ (99,692)**	**$ (99,091)**	**$ (98,430)**	**$ (97,708)**	
Interest Expense (Land)	(23,145)	(22,806)	(22,448)	(22,072)	(21,675)	(21,257)	(20,817)	(20,354)	(19,866)	(19,351)	(18,239)	(18,239)	(17,639)	(17,006)	(16,339)	
Pre-Tax Income	**$ (164,287)**	**$ (133,833)**	**$ (126,874)**	**$ (124,775)**	**$ (124,145)**	**$ (123,461)**	**$ (122,716)**	**$ (121,907)**	**$ (121,029)**	**$ (120,077)**	**$ (118,475)**	**$ (117,931)**	**$ (116,729)**	**$ (115,436)**	**$ (114,048)**	
Income Taxes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Net Income	**$ (164,287)**	**$ (133,833)**	**$ (126,874)**	**$ (124,775)**	**$ (124,145)**	**$ (123,461)**	**$ (122,716)**	**$ (121,907)**	**$ (121,029)**	**$ (120,077)**	**$ (118,475)**	**$ (117,931)**	**$ (116,729)**	**$ (115,436)**	**$ (114,048)**	
Revenue Growth Rate		1,045.1%	196.6%	20.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	Constant
Harvesting & Planting Cost Growth Rate		1,045.1%	196.6%	20.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	Decrease by
Processing Cost Growth Rate		1,045.1%	196.6%	20.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	Decrease by

Illustrative Maryland Commercial Miscanthus Production Cash Flow Statement (Agriculturally Viable Land)

	Actual			Estimated	Projected											
Fiscal	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Projection N**
Net Income	$ (164,287)	$ (133,833)	$ (126,874)	$ (124,775)	$ (124,145)	$ (123,461)	$ (122,716)	$ (121,907)	$ (121,029)	$ (120,077)	$ (118,475)	$ (117,931)	$ (116,729)	$ (115,436)	$ (114,048)	
Cash Flow From Operating Activities																
Depreciation (Harvest & Planting Equipment)	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	
Depreciation (Processing Equipment)	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	
Depreciation (Transportation Equipment)	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	
Amortization (Land)	6,375	6,714	7,072	7,448	7,845	8,263	8,703	9,166	9,655	10,169	10,710	11,281	11,882	12,514	13,181	
Change in Working Capital	(27,225)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Operating Activities	**$ 73,150**	**$ 100,714**	**$ 101,072**	**$ 101,448**	**$ 101,845**	**$ 102,263**	**$ 102,703**	**$ 103,166**	**$ 103,655**	**$ 104,169**	**$ 104,710**	**$ 105,281**	**$ 105,882**	**$ 106,514**	**$ 107,181**	
Cash Flow From Investing Activities																
Harvesting & Planting Equipment	(265,000)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Processing Equipment	(797,000)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Land Acquisition	(560,000)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Transportation Equipment	(182,000)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Investing Activities	**$ (1,804,000)**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Cash Flow from Financing Activities																
Mortgage Loan	448,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash flow from Financing Activities	**$ 448,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Net Change in Cash	**$ (1,447,137)**	**$ (33,119)**	**$ (25,803)**	**$ (23,327)**	**$ (22,300)**	**$ (21,198)**	**$ (20,013)**	**$ (18,741)**	**$ (17,374)**	**$ (15,908)**	**$ (13,765)**	**$ (12,650)**	**$ (10,848)**	**$ (8,922)**	**$ (6,867)**	

GEMSTONE TEAM BIOFUELS

Illustrative Maryland Commercial Miscanthus Production Income Statement (Agriculturally Marginal Land)

	Actual			Estimated	Projected											
Fiscal	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Projection N**
Revenue																
Miscanthus x. Giganteus Sales	$ 73.42	$ 983.18	$ 5,895.57	$ 7,074.68	$ 7,428.42	$ 7,799.84	$ 8,189.83	$ 8,599.32	$ 9,029.29	$ 9,480.75	$ 9,954.79	$ 10,452.53	$ 10,975.16	$ 11,523.91	$ 12,100.11	
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Revenue fron
Total Revenue	**$ 73.42**	**$ 983.18**	**$ 5,895.57**	**$ 7,074.68**	**$ 7,428.42**	**$ 7,799.84**	**$ 8,189.83**	**$ 8,599.32**	**$ 9,029.29**	**$ 9,480.75**	**$ 9,954.79**	**$ 10,452.53**	**$ 10,975.16**	**$ 11,523.91**	**$ 12,100.11**	
Cost of Production																
Harvesting & Planting	(123)	(1,410)	(4,181)	(5,017)	(5,268)	(5,532)	(5,808)	(6,099)	(6,404)	(6,724)	(7,060)	(7,413)	(7,784)	(8,173)	(8,582)	$12.74
Cost of Plants	(27,225)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Includes Dryi
Processing	(109)	(1,250)	(3,709)	(4,450)	(4,673)	(4,883)	(5,078)	(5,256)	(5,414)	(5,549)	(5,660)	(5,745)	(5,803)	(5,832)	(5,832)	
Transportation	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	Constant
Gross Profit	(41,235)	(15,528)	(15,845)	(16,244)	(16,364)	(16,466)	(16,548)	(16,607)	(16,639)	(16,643)	(16,617)	(16,557)	(16,462)	(16,332)	(16,164)	
Operating, SG&A Expenses																
Depreciation (Harvest & Planting Equipment)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	Straight line
Depreciation (Processing Equipment)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	Straight line
Depreciation (Transportation Equipment)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	Straight line
Amortization (Land)	(1,605)	(1,690)	(1,780)	(1,875)	(1,975)	(2,080)	(2,191)	(2,307)	(2,430)	(2,560)	(2,696)	(2,840)	(2,991)	(3,150)	(3,318)	See amortiza
Operating Income	**$ (136,839)**	**$ (111,218)**	**$ (111,625)**	**$ (112,119)**	**$ (112,339)**	**$ (112,546)**	**$ (112,739)**	**$ (112,914)**	**$ (113,070)**	**$ (113,203)**	**$ (113,313)**	**$ (113,396)**	**$ (113,453)**	**$ (113,482)**	**$ (113,482)**	
Interest Expense (Land)	(5,826)	(5,741)	(5,651)	(5,556)	(5,456)	(5,351)	(5,240)	(5,123)	(5,000)	(4,871)	(4,735)	(4,591)	(4,440)	(4,281)	(4,113)	
Pre-Tax Income	**$ (142,665)**	**$ (116,958)**	**$ (117,276)**	**$ (117,675)**	**$ (117,794)**	**$ (117,897)**	**$ (117,979)**	**$ (118,037)**	**$ (118,070)**	**$ (118,074)**	**$ (118,047)**	**$ (117,987)**	**$ (117,893)**	**$ (117,762)**	**$ (117,595)**	
Income Taxes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Net Income	**$ (142,665)**	**$ (116,958)**	**$ (117,276)**	**$ (117,675)**	**$ (117,794)**	**$ (117,897)**	**$ (117,979)**	**$ (118,037)**	**$ (118,070)**	**$ (118,074)**	**$ (118,047)**	**$ (117,987)**	**$ (117,893)**	**$ (117,762)**	**$ (117,595)**	

Revenue Growth Rate		1,239.1%	499.6%	20.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	Constant
Harvesting & Planting Cost Growth Rate		1,045.1%	196.6%	20.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	Decrease by
Processing Cost Growth Rate		1,045.1%	196.6%	20.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	Decrease by

Illustrative Maryland Commercial Miscanthus Production Cash Flow Statement (Agriculturally Marginal Land)

	Actual			Estimated	Projected											
Fiscal	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Projection N**
Net Income	$ (142,665)	$ (116,958)	$ (117,276)	$ (117,675)	$ (117,794)	$ (117,897)	$ (117,979)	$ (118,037)	$ (118,070)	$ (118,074)	$ (118,047)	$ (117,987)	$ (117,893)	$ (117,762)	$ (117,595)	
Cash Flow From Operating Activities																
Depreciation (Harvest & Planting Equipment)	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	
Depreciation (Processing Equipment)	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	
Depreciation (Transportation Equipment)	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	
Amortization (Land)	1,605	1,690	1,780	1,875	1,975	2,080	2,191	2,307	2,430	2,560	2,696	2,840	2,991	3,150	3,318	
Change in Working Capital	(27,225.00)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Operating Activities	**$ 68,379.61**	**$ 95,690.06**	**$ 95,780.07**	**$ 95,874.87**	**$ 95,974.72**	**$ 96,079.89**	**$ 96,190.66**	**$ 96,307.33**	**$ 96,430.21**	**$ 96,559.64**	**$ 96,695.96**	**$ 96,839.54**	**$ 96,990.77**	**$ 97,150.05**	**$ 97,317.81**	
Cash Flow From Investing Activities																
Harvesting & Planting Equipment	$ (265,000)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
Processing Equipment	(797,000)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Land Acquisition	(140,960)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Transportation Equipment	(182,000)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Investing Activities	**$ (1,384,960)**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Cash Flow from Financing Activities																
Mortgage Loan	$ 112,768	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
Cash Flow From Investing Activities	**$ 112,768**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Net Change in Cash	**$ (1,346,478)**	**$ (21,268)**	**$ (21,496)**	**$ (21,800)**	**$ (21,820)**	**$ (21,817)**	**$ (21,788)**	**$ (21,730)**	**$ (21,640)**	**$ (21,514)**	**$ (21,351)**	**$ (21,148)**	**$ (20,902)**	**$ (20,612)**	**$ (20,277)**	

Processing Equipment Depreciation Schedule

Item	Purchase Price	Installation	Useful Life	Annual Depreciation
Dryer	$ -	$ -	$ 15	$ -
Pellet Mill	-	-	15	-
Pellet Cooler	-	-	15	-
Miscellaneous Equipment	-	-	15	-
Annual Depreciation				$ -

Processing Cost Schedule ($ / Ton)

Drying	$ 7.84
Pelletizing	2.09
Packaging	1.37

Tons Produced

Year 1	9.66
Year 2	110.64
Year 3	328.20

Transportation Equipment Depreciation Schedule

Item	Purchase Price	Useful Life	Annual Depreciation
Loader	$ -	$ 15	$ -
Truck	-	15	-
Total			**$ -**

Harvesting and Planting Equipment Depreciation Schedule

Item	Purchase Price	Useful Life	Annual Depreciation
Forage Harvester	$ -	15	$ -
Potato Planter	-	15	-
Tractor	-	15	-
Total			**$ -**

Facility Information

	Hectares	Acres
Average MD Farm	64.75	160
MD Price Per Acre		$ -
Land Purchase Price		$ -
Marginal Land Price Per Acre		$ -
Land Acquisition Price		$ -
Price Per Miscanthus Rhizome		$ 2.25
Acres Per Hectare		2.4710538

Transportation Fixed Costs

Registration, Permits & Fees	$ 6,970
Insurance (Vehicle)	3,290
Insurance (Goods-in-Transit)	500
Insurance (Personal Sickness)	450
Insurance (Public Liability)	405
Insurance (Workers' Comp)	1,533
Total	**$ 13,148**

Transportation Variable Costs Per Mile

Fuel (3.872 Per Gallon)	$ 0.55
Tires	0.03
Servicing & Maintenance	0.12
Total	**$ 0.70**

Assumptions

Land Price (%)	**0.0%**
Subsidy Amount	100.0%
Equipment Purchased	**0.0%**
Equipment Owned	100.0%
Choose	**8**
Miscanthus Price	$ 56.02

GEMSTONE TEAM BIOFUELS

Illustrative Maryland Commercial Miscanthus Production Income Statement (Agriculturally Viable Land)

	Actual			Estimated	Projected											
Fiscal	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Projection I**
Revenue																
Miscanthus x. Giganteus Sales	$ 541	$ 6,198	$ 18,387	$ 22,064	$ 23,167	$ 24,325	$ 25,542	$ 26,819	$ 28,160	$ 29,568	$ 31,046	$ 32,598	$ 34,228	$ 35,940	$ 37,737	
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Revenue fron
Total Revenue	**$ 541**	**$ 6,198**	**$ 18,387**	**$ 22,064**	**$ 23,167**	**$ 24,325**	**$ 25,542**	**$ 26,819**	**$ 28,160**	**$ 29,568**	**$ 31,046**	**$ 32,598**	**$ 34,228**	**$ 35,940**	**$ 37,737**	
Cost of Production																
Harvesting & Planting	(123)	(1,410)	(4,181)	(5,017)	(5,268)	(5,532)	(5,808)	(6,099)	(6,404)	(6,724)	(7,060)	(7,413)	(7,784)	(8,173)	(8,582)	$12.74
Cost of Plants	(27,225)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Includes Dryi
Processing	(109)	(1,250)	(3,709)	(4,450)	(4,673)	(4,883)	(5,078)	(5,256)	(5,414)	(5,549)	(5,660)	(5,745)	(5,803)	(5,832)	(5,832)	
Transportation	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	Constant
Gross Profit	(40,767)	(10,313)	(3,354)	(1,255)	(625)	60	804	1,613	2,491	3,444	4,475	5,589	6,791	8,084	9,473	
Operating, SG&A Expenses																
Depreciation (Harvest & Planting Equipment)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Straight line
Depreciation (Processing Equipment)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Straight line
Depreciation (Transportation Equipment)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Straight line
Amortization (Land)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	See amortiza
Operating Income	**$ (40,767)**	**$ (10,313)**	**$ (3,354)**	**$ (1,255)**	**$ (625)**	**$ 60**	**$ 804**	**$ 1,613**	**$ 2,491**	**$ 3,444**	**$ 4,475**	**$ 5,589**	**$ 6,791**	**$ 8,084**	**$ 9,473**	
Interest Expense (Land)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Pre-Tax Income	**$ (40,767)**	**$ (10,313)**	**$ (3,354)**	**$ (1,255)**	**$ (625)**	**$ 60**	**$ 804**	**$ 1,613**	**$ 2,491**	**$ 3,444**	**$ 4,475**	**$ 5,589**	**$ 6,791**	**$ 8,084**	**$ 9,473**	
Income Taxes	-	-	-	-	-	17.9	241.2	483.8	747.3	1,033.1	1,342.4	1,676.8	2,037.3	2,425.3	2,841.8	
Net Income	**$ (40,767)**	**$ (10,313)**	**$ (3,354)**	**$ (1,255)**	**$ (625)**	**$ 77**	**$ 1,045**	**$ 2,097**	**$ 3,238**	**$ 4,477**	**$ 5,817**	**$ 7,266**	**$ 8,828**	**$ 10,509**	**$ 12,314**	
Revenue Growth Rate		1,045.1%	196.6%	20.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	Constant
Harvesting & Planting Cost Growth Rate		1,045.1%	196.6%	20.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	Decrease by
Processing Cost Growth Rate		1,045.1%	196.6%	20.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	Decrease by

Illustrative Maryland Commercial Miscanthus Production Cash Flow Statement (Agriculturally Viable Land)

	Actual			Estimated	Projected											
Fiscal	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Projection I**
Net Income	$ (40,767)	$ (10,313)	$ (3,354)	$ (1,255)	$ (625)	$ 77	$ 1,045	$ 2,097	$ 3,238	$ 4,477	$ 5,817	$ 7,266	$ 8,828	$ 10,509	$ 12,314	
Cash Flow From Operating Activities																
Depreciation (Harvest & Planting Equipment)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Depreciation (Processing Equipment)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Depreciation (Transportation Equipment)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Amortization (Land)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Change in Working Capital	(27,225)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Operating Activities	**$ (27,225)**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Cash Flow From Investing Activities																
Harvesting & Planting Equipment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Processing Equipment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Land Acquisition	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Transportation Equipment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Investing Activities	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Cash Flow from Financing Activities																
Mortgage Loan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash flow from Financing Activities	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Net Change in Cash	**$ (67,992)**	**$ (10,313)**	**$ (3,354)**	**$ (1,255)**	**$ (625)**	**$ 77**	**$ 1,045**	**$ 2,097**	**$ 3,238**	**$ 4,477**	**$ 5,817**	**$ 7,266**	**$ 8,828**	**$ 10,509**	**$ 12,314**	

GEMSTONE TEAM BIOFUELS

Illustrative Maryland Commercial Miscanthus Production Income Statement (Agriculturally Marginal Land)

Fiscal	Actual **Year 1**	 **Year 2**	 **Year 3**	Estimated **Year 4**	Projected **Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Projection I**
Revenue																
Miscanthus x. Giganteus Sales	$ 73.42	$ 983.18	$ 5,895.57	$ 7,074.68	$ 7,428.42	$ 7,799.84	$ 8,189.83	$ 8,599.32	$ 9,029.29	$ 9,480.75	$ 9,954.79	$ 10,452.53	$ 10,975.16	$ 11,523.91	$ 12,100.11	
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Revenue fron
Total Revenue	**$ 73.42**	**$ 983.18**	**$ 5,895.57**	**$ 7,074.68**	**$ 7,428.42**	**$ 7,799.84**	**$ 8,189.83**	**$ 8,599.32**	**$ 9,029.29**	**$ 9,480.75**	**$ 9,954.79**	**$ 10,452.53**	**$ 10,975.16**	**$ 11,523.91**	**$ 12,100.11**	
Cost of Production																
Harvesting & Planting	(123)	(1,410)	(4,181)	(5,017)	(5,268)	(5,532)	(5,808)	(6,099)	(6,404)	(6,724)	(7,060)	(7,413)	(7,784)	(8,173)	(8,582)	$12.74
Cost of Plants	(27,225)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Includes Dryi
Processing	(109)	(1,250)	(3,709)	(4,450)	(4,673)	(4,883)	(5,078)	(5,256)	(5,414)	(5,549)	(5,660)	(5,745)	(5,803)	(5,832)	(5,832)	
Transportation	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	Constant
Gross Profit	(41,235)	(15,528)	(15,845)	(16,244)	(16,364)	(16,466)	(16,548)	(16,607)	(16,639)	(16,643)	(16,617)	(16,557)	(16,462)	(16,332)	(16,164)	
Operating, SG&A Expenses																
Depreciation (Harvest & Planting Equipment)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	Straight line
Depreciation (Processing Equipment)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Straight line
Depreciation (Transportation Equipment)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Straight line
Amortization (Land)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	See amortiz
Operating Income	**$ (41,235)**	**$ (15,528)**	**$ (15,845)**	**$ (16,244)**	**$ (16,364)**	**$ (16,466)**	**$ (16,548)**	**$ (16,607)**	**$ (16,639)**	**$ (16,643)**	**$ (16,617)**	**$ (16,557)**	**$ (16,462)**	**$ (16,332)**	**$ (16,164)**	
Interest Expense (Land)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Pre-Tax Income	**$ (41,235)**	**$ (15,528)**	**$ (15,845)**	**$ (16,244)**	**$ (16,364)**	**$ (16,466)**	**$ (16,548)**	**$ (16,607)**	**$ (16,639)**	**$ (16,643)**	**$ (16,617)**	**$ (16,557)**	**$ (16,462)**	**$ (16,332)**	**$ (16,164)**	
Income Taxes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Net Income	**$ (41,235)**	**$ (15,528)**	**$ (15,845)**	**$ (16,244)**	**$ (16,364)**	**$ (16,466)**	**$ (16,548)**	**$ (16,607)**	**$ (16,639)**	**$ (16,643)**	**$ (16,617)**	**$ (16,557)**	**$ (16,462)**	**$ (16,332)**	**$ (16,164)**	
Revenue Growth Rate		1,239.1%	499.6%	20.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	Constant
Harvesting & Planting Cost Growth Rate		1,045.1%	196.6%	20.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	Decrease by
Processing Cost Growth Rate		1,045.1%	196.6%	20.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	Decrease by

Illustrative Maryland Commercial Miscanthus Production Cash Flow Statement (Agriculturally Marginal Land)

Fiscal	Actual **Year 1**	 **Year 2**	 **Year 3**	Estimated **Year 4**	Projected **Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Projection I**
Net Income	$ (41,235)	$ (15,528)	$ (15,845)	$ (16,244)	$ (16,364)	$ (16,466)	$ (16,548)	$ (16,607)	$ (16,639)	$ (16,643)	$ (16,617)	$ (16,557)	$ (16,462)	$ (16,332)	$ (16,164)	
Cash Flow From Operating Activities																
Depreciation (Harvest & Planting Equipment)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Depreciation (Processing Equipment)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Depreciation (Transportation Equipment)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Amortization (Land)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Change in Working Capital	(27,225.00)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Operating Activities	**$ (27,225.00)**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Cash Flow From Investing Activities																
Harvesting & Planting Equipment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
Processing Equipment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Land Acquisition	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Transportation Equipment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Investing Activities	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Cash Flow from Financing Activities																
Mortgage Loan	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
Cash Flow From Investing Activities	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Net Change in Cash	**$ (68,460)**	**$ (15,528)**	**$ (15,845)**	**$ (16,244)**	**$ (16,364)**	**$ (16,466)**	**$ (16,548)**	**$ (16,607)**	**$ (16,639)**	**$ (16,643)**	**$ (16,617)**	**$ (16,557)**	**$ (16,462)**	**$ (16,332)**	**$ (16,164)**	

Scenario Two Revenue & Worst Case Expenses

Processing Equipment Depreciation Schedule

Item	Purchase Price	Installation	Useful Life	Annual Depreciation
Dryer	$ 350,000	$ 71,000	$ 15	$ 28,067
Pellet Mill	315,000	71,000	15	25,733
Pellet Cooler	32,000	24,000	15	3,733
Miscellaneous Equipment	100,000	-	15	6,667
Annual Depreciation				$ 64,200

Processing Cost Schedule ($ / Ton)

Drying	$ 7.84
Pelletizing	2.09
Packaging	1.37

Tons Produced

Year 1	9.66
Year 2	110.64
Year 3	328.20

Transportation Equipment Depreciation Schedule

Item	Purchase Price	Useful Life	Annual Depreciation
Loader	$ 82,000	$ 15	$ 5,467
Truck	100,000	15	6,667
Total			**$ 12,133**

Harvesting and Planting Equipment Depreciation Schedule

Item	Purchase Price	Useful Life	Annual Depreciation
Forage Harvester	$ 29,000	15	$ 1,933.33
Potato Planter	86,000	15	5,733.33
Tractor	150,000	15	10,000.00
Total			**$ 17,666.67**

Facility Information

	Hectares	Acres
Average MD Farm	64.75	160
MD Price Per Acre		$ 7,000
Land Purchase Price		$ 1,120,000
Marginal Land Price Per Acre		$ 1,762
Land Acquisition Price		$ 281,920
Price Per Miscanthus Rhizome		$ 2.25
Acres Per Hectare		2.4710538

Transportation Fixed Costs

Registration, Permits & Fees	$ 6,970
Insurance (Vehicle)	3,290
Insurance (Goods-in-Transit)	500
Insurance (Personal Sickness)	450
Insurance (Public Liability)	405
Insurance (Workers' Comp)	1,533
Total	**$ 13,148**

Transportation Variable Costs Per Mile

Fuel (3.872 Per Gallon)	$ 0.55
Tires	0.03
Servicing & Maintenance	0.12
Total	**$ 0.70**

Assumptions

Land Price (%)	100.0%
Subsidy Amount	0.0%
Equipment Purchased	100.0%
Equipment Owned	0.0%
Choose	10
Miscanthus Price	$ 160.07

GEMSTONE TEAM BIOFUELS

Illustrative Maryland Commercial Miscanthus Production Income Statement (Agriculturally Viable Land)

		Actual		Estimated						Projected						
Fiscal	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Projection N**
Revenue																
Miscanthus x. Giganteus Sales	$ 1,546	$ 17,709	$ 52,533	$ 63,040	$ 66,192	$ 69,501	$ 72,976	$ 76,625	$ 80,456	$ 84,479	$ 88,703	$ 93,138	$ 97,795	$ 102,685	$ 107,819	
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Revenue fron
Total Revenue	**$ 1,546**	**$ 17,709**	**$ 52,533**	**$ 63,040**	**$ 66,192**	**$ 69,501**	**$ 72,976**	**$ 76,625**	**$ 80,456**	**$ 84,479**	**$ 88,703**	**$ 93,138**	**$ 97,795**	**$ 102,685**	**$ 107,819**	
Cost of Production																
Harvesting & Planting	(123)	(1,410)	(4,181)	(5,017)	(5,268)	(5,532)	(5,808)	(6,099)	(6,404)	(6,724)	(7,060)	(7,413)	(7,784)	(8,173)	(8,582)	$12.74
Cost of Plants	(27,225)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Includes Dryi
Processing	(109)	(1,250)	(3,709)	(4,450)	(4,673)	(4,883)	(5,078)	(5,256)	(5,414)	(5,549)	(5,660)	(5,745)	(5,803)	(5,832)	(5,832)	
Transportation	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	Constant
Gross Profit	(39,762)	1,198	30,792	39,721	42,399	45,235	48,239	51,419	54,788	58,355	62,132	66,129	70,358	74,830	79,555	
Operating, SG&A Expenses																
Depreciation (Harvest & Planting Equipment)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	Straight line
Depreciation (Processing Equipment)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	Straight line
Depreciation (Transportation Equipment)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	Straight line
Amortization (Land)	(12,749)	(13,428)	(14,144)	(14,897)	(15,690)	(16,526)	(17,406)	(18,333)	(19,309)	(20,338)	(21,421)	(22,562)	(23,763)	(25,029)	(26,362)	See amortiza
Operating Income	**$ (146,511)**	**$ (106,230)**	**$ (77,351)**	**$ (69,176)**	**$ (67,291)**	**$ (65,290)**	**$ (63,167)**	**$ (60,914)**	**$ (58,521)**	**$ (55,983)**	**$ (53,289)**	**$ (50,432)**	**$ (47,405)**	**$ (44,199)**	**$ (40,807)**	
Interest Expense (Land)	(46,291)	(45,612)	(44,897)	(44,144)	(43,350)	(42,515)	(41,634)	(40,707)	(39,731)	(38,703)	(36,479)	(36,479)	(35,277)	(34,012)	(32,679)	
Pre-Tax Income	**$ (192,802)**	**$ (151,842)**	**$ (122,248)**	**$ (113,320)**	**$ (110,641)**	**$ (107,805)**	**$ (104,802)**	**$ (101,621)**	**$ (98,253)**	**$ (94,685)**	**$ (89,768)**	**$ (86,911)**	**$ (82,682)**	**$ (78,211)**	**$ (73,485)**	
Income Taxes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Net Income	**$ (192,802)**	**$ (151,842)**	**$ (122,248)**	**$ (113,320)**	**$ (110,641)**	**$ (107,805)**	**$ (104,802)**	**$ (101,621)**	**$ (98,253)**	**$ (94,685)**	**$ (89,768)**	**$ (86,911)**	**$ (82,682)**	**$ (78,211)**	**$ (73,485)**	

Revenue Growth Rate		1,045.1%	196.6%	20.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	Constant
Harvesting & Planting Cost Growth Rate		1,045.1%	196.6%	20.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	Decrease by
Processing Cost Growth Rate		1,045.1%	196.6%	20.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	Decrease by

Illustrative Maryland Commercial Miscanthus Production Cash Flow Statement (Agriculturally Viable Land)

		Actual		Estimated						Projected						
Fiscal	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Projection N**
Net Income	$ (192,802)	$ (151,842)	$ (122,248)	$ (113,320)	$ (110,641)	$ (107,805)	$ (104,802)	$ (101,621)	$ (98,253)	$ (94,685)	$ (89,768)	$ (86,911)	$ (82,682)	$ (78,211)	$ (73,485)	
Cash Flow From Operating Activities																
Depreciation (Harvest & Planting Equipment)	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	
Depreciation (Processing Equipment)	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	
Depreciation (Transportation Equipment)	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	
Amortization (Land)	12,749	13,428	14,144	14,897	15,690	16,526	17,406	18,333	19,309	20,338	21,421	22,562	23,763	25,029	26,362	
Change in Working Capital	(27,225)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Operating Activities	**$ 79,524**	**$ 107,428**	**$ 108,144**	**$ 108,897**	**$ 109,690**	**$ 110,526**	**$ 111,406**	**$ 112,333**	**$ 113,309**	**$ 114,338**	**$ 115,421**	**$ 116,562**	**$ 117,763**	**$ 119,029**	**$ 120,362**	
Cash Flow From Investing Activities																
Harvesting & Planting Equipment	(265,000)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Processing Equipment	(797,000)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Land Acquisition	(1,120,000)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Transportation Equipment	(182,000)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Investing Activities	**$ (2,364,000)**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Cash Flow from Financing Activities																
Mortgage Loan	896,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash flow from Financing Activities	**$ 896,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Net Change in Cash	**$ (1,581,278)**	**$ (44,414)**	**$ (14,105)**	**$ (4,423)**	**$ (951)**	**$ 2,721**	**$ 6,604**	**$ 10,712**	**$ 15,057**	**$ 19,652**	**$ 25,653**	**$ 29,650**	**$ 35,081**	**$ 40,818**	**$ 46,876**	

GEMSTONE TEAM BIOFUELS

Illustrative Maryland Commercial Miscanthus Production Income Statement (Agriculturally Marginal Land)

	Actual			Estimated	Projected											
Fiscal	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Projection N**
Revenue																
Miscanthus x. Giganteus Sales	$ 209.78	$ 2,809.09	$ 16,844.49	$ 20,213.38	$ 21,224.05	$ 22,285.25	$ 23,399.52	$ 24,569.49	$ 25,797.97	$ 27,087.87	$ 28,442.26	$ 29,864.37	$ 31,357.59	$ 32,925.47	$ 34,571.74	
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Revenue fron
Total Revenue	**$ 209.78**	**$ 2,809.09**	**$ 16,844.49**	**$ 20,213.38**	**$ 21,224.05**	**$ 22,285.25**	**$ 23,399.52**	**$ 24,569.49**	**$ 25,797.97**	**$ 27,087.87**	**$ 28,442.26**	**$ 29,864.37**	**$ 31,357.59**	**$ 32,925.47**	**$ 34,571.74**	
Cost of Production																
Harvesting & Planting	(123)	(1,410)	(4,181)	(5,017)	(5,268)	(5,532)	(5,808)	(6,099)	(6,404)	(6,724)	(7,060)	(7,413)	(7,784)	(8,173)	(8,582)	$12.74
Cost of Plants	(27,225)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Includes Dryi
Processing	(109)	(1,250)	(3,709)	(4,450)	(4,673)	(4,883)	(5,078)	(5,256)	(5,414)	(5,549)	(5,660)	(5,745)	(5,803)	(5,832)	(5,832)	
Transportation	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	Constant
Gross Profit	(41,098)	(13,702)	(4,896)	(3,105)	(2,568)	(1,981)	(1,338)	(637)	129	964	1,871	2,855	3,920	5,070	6,308	
Operating, SG&A Expenses																
Depreciation (Harvest & Planting Equipment)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	Straight line
Depreciation (Processing Equipment)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	Straight line
Depreciation (Transportation Equipment)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	Straight line
Amortization (Land)	(3,209)	(3,380)	(3,560)	(3,750)	(3,949)	(4,160)	(4,381)	(4,615)	(4,860)	(5,119)	(5,392)	(5,679)	(5,982)	(6,300)	(6,636)	See amortiza
Operating Income	**$ (138,308)**	**$ (111,082)**	**$ (102,457)**	**$ (100,855)**	**$ (100,518)**	**$ (100,140)**	**$ (99,720)**	**$ (99,251)**	**$ (98,731)**	**$ (98,156)**	**$ (97,521)**	**$ (96,824)**	**$ (96,061)**	**$ (95,230)**	**$ (94,328)**	
Interest Expense (Land)	(11,652)	(11,481)	(11,301)	(11,112)	(10,912)	(10,702)	(10,480)	(10,247)	(10,001)	(9,742)	(9,469)	(9,182)	(8,880)	(8,561)	(8,226)	
Pre-Tax Income	**$ (149,960)**	**$ (122,563)**	**$ (113,758)**	**$ (111,967)**	**$ (111,430)**	**$ (110,842)**	**$ (110,200)**	**$ (109,498)**	**$ (108,732)**	**$ (107,898)**	**$ (106,990)**	**$ (106,006)**	**$ (104,941)**	**$ (103,791)**	**$ (102,554)**	
Income Taxes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Net Income	**$ (149,960)**	**$ (122,563)**	**$ (113,758)**	**$ (111,967)**	**$ (111,430)**	**$ (110,842)**	**$ (110,200)**	**$ (109,498)**	**$ (108,732)**	**$ (107,898)**	**$ (106,990)**	**$ (106,006)**	**$ (104,941)**	**$ (103,791)**	**$ (102,554)**	
Revenue Growth Rate		1,239.1%	499.6%	20.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	Constant
Harvesting & Planting Cost Growth Rate		1,045.1%	196.6%	20.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	Decrease by
Processing Cost Growth Rate		1,045.1%	196.6%	20.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	Decrease by

Illustrative Maryland Commercial Miscanthus Production Cash Flow Statement (Agriculturally Marginal Land)

	Actual			Estimated	Projected											
Fiscal	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Projection N**
Net Income	$ (149,960)	$ (122,563)	$ (113,758)	$ (111,967)	$ (111,430)	$ (110,842)	$ (110,200)	$ (109,498)	$ (108,732)	$ (107,898)	$ (106,990)	$ (106,006)	$ (104,941)	$ (103,791)	$ (102,554)	
Cash Flow From Operating Activities																
Depreciation (Harvest & Planting Equipment)	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	
Depreciation (Processing Equipment)	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	
Depreciation (Transportation Equipment)	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	
Amortization (Land)	3,209	3,380	3,560	3,750	3,949	4,160	4,381	4,615	4,860	5,119	5,392	5,679	5,982	6,300	6,636	
Change in Working Capital	(27,225.00)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Operating Activities	**$ 69,984.21**	**$ 97,380.12**	**$ 97,560.14**	**$ 97,749.75**	**$ 97,949.45**	**$ 98,159.78**	**$ 98,381.32**	**$ 98,614.66**	**$ 98,860.43**	**$ 99,119.28**	**$ 99,391.92**	**$ 99,679.08**	**$ 99,981.53**	**$ 100,300.09**	**$ 100,635.62**	
Cash Flow From Investing Activities																
Harvesting & Planting Equipment	$ (265,000)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
Processing Equipment	(797,000)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Land Acquisition	(281,920)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Transportation Equipment	(182,000)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Investing Activities	**$ (1,525,920)**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Cash Flow from Financing Activities																
Mortgage Loan	$ 225,536	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
Cash Flow From Investing Activities	**$ 225,536**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Net Change in Cash	**$ (1,380,360)**	**$ (25,183)**	**$ (16,198)**	**$ (14,217)**	**$ (13,480)**	**$ (12,682)**	**$ (11,818)**	**$ (10,883)**	**$ (9,872)**	**$ (8,778)**	**$ (7,598)**	**$ (6,327)**	**$ (4,960)**	**$ (3,491)**	**$ (1,918)**	

Scenario Two Revenue & Base Case Expenses

Processing Equipment Depreciation Schedule

Item	Purchase Price	Installation	Useful Life	Annual Depreciation
Dryer	$ 175,000	$ 71,000	$ 15	$ 16,400
Pellet Mill	157,500	71,000	15	15,233
Pellet Cooler	16,000	24,000	15	2,667
Miscellaneous Equipment	50,000	-	15	3,333
Annual Depreciation				$ 37,633

Processing Cost Schedule ($ / Ton)

Drying	$ 7.84
Pelletizing	2.09
Packaging	1.37

Tons Produced

Year 1	9.66
Year 2	110.64
Year 3	328.20

Transportation Equipment Depreciation Schedule

Item	Purchase Price	Useful Life	Annual Depreciation
Loader	$ 41,000	$ 15	$ 2,733
Truck	50,000	15	3,333
Total			**$ 6,067**

Harvesting and Planting Equipment Depreciation Schedule

Item	Purchase Price	Useful Life	Annual Depreciation
Forage Harvester	$ 14,500	15	$ 966.67
Potato Planter	43,000	15	2,866.67
Tractor	75,000	15	5,000.00
Total			**$ 8,833.33**

Facility Information

	Hectares	Acres
Average MD Farm	64.75	160
MD Price Per Acre		$ 3,500
Land Purchase Price		$ 560,000
Marginal Land Price Per Acre		$ 881
Land Acquisition Price		$ 140,960
Price Per Miscanthus Rhizome		$ 2.25
Acres Per Hectare		2.4710538

Transportation Fixed Costs

Registration, Permits & Fees	$ 6,970
Insurance (Vehicle)	3,290
Insurance (Goods-in-Transit)	500
Insurance (Personal Sickness)	450
Insurance (Public Liability)	405
Insurance (Workers' Comp)	1,533
Total	**$ 13,148**

Transportation Variable Costs Per Mile

Fuel (3.872 Per Gallon)	$ 0.55
Tires	0.03
Servicing & Maintenance	0.12
Total	**$ 0.70**

Assumptions

Land Price (%)	**50.0%**
Subsidy Amount	50.0%
Equipment Purchased	**50.0%**
Equipment Owned	50.0%
Choose	**10**
Miscanthus Price	$ 160.07

GEMSTONE TEAM BIOFUELS

Illustrative Maryland Commercial Miscanthus Production Income Statement (Agriculturally Viable Land)

	Actual			Estimated					Projected							
Fiscal	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Projection N**
Revenue																
Miscanthus x. Giganteus Sales	$ 1,546	$ 17,709	$ 52,533	$ 63,040	$ 66,192	$ 69,501	$ 72,976	$ 76,625	$ 80,456	$ 84,479	$ 88,703	$ 93,138	$ 97,795	$ 102,685	$ 107,819	
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Revenue fron
Total Revenue	**$ 1,546**	**$ 17,709**	**$ 52,533**	**$ 63,040**	**$ 66,192**	**$ 69,501**	**$ 72,976**	**$ 76,625**	**$ 80,456**	**$ 84,479**	**$ 88,703**	**$ 93,138**	**$ 97,795**	**$ 102,685**	**$ 107,819**	
Cost of Production																
Harvesting & Planting	(123)	(1,410)	(4,181)	(5,017)	(5,268)	(5,532)	(5,808)	(6,099)	(6,404)	(6,724)	(7,060)	(7,413)	(7,784)	(8,173)	(8,582)	$12.74
Cost of Plants	(27,225)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Includes Dryi
Processing	(109)	(1,250)	(3,709)	(4,450)	(4,673)	(4,883)	(5,078)	(5,256)	(5,414)	(5,549)	(5,660)	(5,745)	(5,803)	(5,832)	(5,832)	
Transportation	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	Constant
Gross Profit	(39,762)	1,198	30,792	39,721	42,399	45,235	48,239	51,419	54,788	58,355	62,132	66,129	70,358	74,830	79,555	
Operating, SG&A Expenses																
Depreciation (Harvest & Planting Equipment)	(8,833)	(8,833)	(8,833)	(8,833)	(8,833)	(8,833)	(8,833)	(8,833)	(8,833)	(8,833)	(8,833)	(8,833)	(8,833)	(8,833)	(8,833)	Straight line
Depreciation (Processing Equipment)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	Straight line
Depreciation (Transportation Equipment)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	Straight line
Amortization (Land)	(6,375)	(6,714)	(7,072)	(7,448)	(7,845)	(8,263)	(8,703)	(9,166)	(9,655)	(10,169)	(10,710)	(11,281)	(11,882)	(12,514)	(13,181)	See amortiza
Operating Income	**$ (98,670)**	**$ (58,049)**	**$ (28,813)**	**$ (20,261)**	**$ (17,979)**	**$ (15,561)**	**$ (12,998)**	**$ (10,281)**	**$ (7,400)**	**$ (4,347)**	**$ (1,112)**	**$ 2,315**	**$ 5,943**	**$ 9,782**	**$ 13,841**	
Interest Expense (Land)	(23,145)	(22,806)	(22,448)	(22,072)	(21,675)	(21,257)	(20,817)	(20,354)	(19,866)	(19,351)	(18,239)	(18,239)	(17,639)	(17,006)	(16,339)	
Pre-Tax Income	**$ (121,815)**	**$ (80,855)**	**$ (51,261)**	**$ (42,333)**	**$ (39,654)**	**$ (36,818)**	**$ (33,815)**	**$ (30,634)**	**$ (27,266)**	**$ (23,698)**	**$ (19,351)**	**$ (15,924)**	**$ (11,696)**	**$ (7,224)**	**$ (2,498)**	
Income Taxes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Net Income	**$ (121,815)**	**$ (80,855)**	**$ (51,261)**	**$ (42,333)**	**$ (39,654)**	**$ (36,818)**	**$ (33,815)**	**$ (30,634)**	**$ (27,266)**	**$ (23,698)**	**$ (19,351)**	**$ (15,924)**	**$ (11,696)**	**$ (7,224)**	**$ (2,498)**	
Revenue Growth Rate		1,045.1%	196.6%	20.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	Constant
Harvesting & Planting Cost Growth Rate		1,045.1%	196.6%	20.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	Decrease by
Processing Cost Growth Rate		1,045.1%	196.6%	20.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	Decrease by

Illustrative Maryland Commercial Miscanthus Production Cash Flow Statement (Agriculturally Viable Land)

	Actual			Estimated					Projected							
Fiscal	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Projection N**
Net Income	$ (121,815)	$ (80,855)	$ (51,261)	$ (42,333)	$ (39,654)	$ (36,818)	$ (33,815)	$ (30,634)	$ (27,266)	$ (23,698)	$ (19,351)	$ (15,924)	$ (11,696)	$ (7,224)	$ (2,498)	
Cash Flow From Operating Activities																
Depreciation (Harvest & Planting Equipment)	8,833	8,833	8,833	8,833	8,833	8,833	8,833	8,833	8,833	8,833	8,833	8,833	8,833	8,833	8,833	
Depreciation (Processing Equipment)	37,633	37,633	37,633	37,633	37,633	37,633	37,633	37,633	37,633	37,633	37,633	37,633	37,633	37,633	37,633	
Depreciation (Transportation Equipment)	6,067	6,067	6,067	6,067	6,067	6,067	6,067	6,067	6,067	6,067	6,067	6,067	6,067	6,067	6,067	
Amortization (Land)	6,375	6,714	7,072	7,448	7,845	8,263	8,703	9,166	9,655	10,169	10,710	11,281	11,882	12,514	13,181	
Change in Working Capital	(27,225)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Operating Activities	**$ 31,683**	**$ 59,248**	**$ 59,605**	**$ 59,982**	**$ 60,378**	**$ 60,796**	**$ 61,236**	**$ 61,700**	**$ 62,188**	**$ 62,702**	**$ 63,244**	**$ 63,814**	**$ 64,415**	**$ 65,048**	**$ 65,714**	
Cash Flow From Investing Activities																
Harvesting & Planting Equipment	(132,500)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Processing Equipment	(398,500)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Land Acquisition	(560,000)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Transportation Equipment	(91,000)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Investing Activities	**$ (1,182,000)**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Cash Flow from Financing Activities																
Mortgage Loan	448,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash flow from Financing Activities	**$ 448,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Net Change in Cash	**$ (824,132)**	**$ (21,608)**	**$ 8,344**	**$ 17,649**	**$ 20,724**	**$ 23,978**	**$ 27,421**	**$ 31,065**	**$ 34,922**	**$ 39,004**	**$ 43,892**	**$ 47,890**	**$ 52,719**	**$ 57,824**	**$ 63,216**	

GEMSTONE TEAM BIOFUELS

Illustrative Maryland Commercial Miscanthus Production Income Statement (Agriculturally Marginal Land)

	Actual			Estimated	Projected											
Fiscal	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Projection I**
Revenue																
Miscanthus x. Giganteus Sales	209.78	2,809.09	16,844.49	20,213.38	21,224.05	22,285.25	23,399.52	24,569.49	25,797.97	27,087.87	28,442.26	29,864.37	31,357.59	32,925.47	34,571.74	
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Revenue fron
Total Revenue	**209.78**	**2,809.09**	**16,844.49**	**20,213.38**	**21,224.05**	**22,285.25**	**23,399.52**	**24,569.49**	**25,797.97**	**27,087.87**	**28,442.26**	**29,864.37**	**31,357.59**	**32,925.47**	**34,571.74**	
Cost of Production																
Harvesting & Planting	(123)	(1,410)	(4,181)	(5,017)	(5,268)	(5,532)	(5,808)	(6,099)	(6,404)	(6,724)	(7,060)	(7,413)	(7,784)	(8,173)	(8,582)	$12.74
Cost of Plants	(27,225)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Includes Dryi
Processing	(109)	(1,250)	(3,709)	(4,450)	(4,673)	(4,883)	(5,078)	(5,256)	(5,414)	(5,549)	(5,660)	(5,745)	(5,803)	(5,832)	(5,832)	
Transportation	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	Constant
Gross Profit	(41,098)	(13,702)	(4,896)	(3,105)	(2,568)	(1,981)	(1,338)	(637)	129	964	1,871	2,855	3,920	5,070	6,308	
Operating, SG&A Expenses																
Depreciation (Harvest & Planting Equipment)	(8,833.33)	(8,833.33)	(8,833.33)	(8,833.33)	(8,833.33)	(8,833.33)	(8,833.33)	(8,833.33)	(8,833.33)	(8,833.33)	(8,833.33)	(8,833.33)	(8,833.33)	(8,833.33)	(8,833.33)	Straight line
Depreciation (Processing Equipment)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	Straight line
Depreciation (Transportation Equipment)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	Straight line
Amortization (Land)	(1,605)	(1,690)	(1,780)	(1,875)	(1,975)	(2,080)	(2,191)	(2,307)	(2,430)	(2,560)	(2,696)	(2,840)	(2,991)	(3,150)	(3,318)	See amortiza
Operating Income	**(95,236)**	**(67,925)**	**(59,210)**	**(57,514)**	**(57,076)**	**(56,594)**	**(56,062)**	**(55,477)**	**(54,834)**	**(54,129)**	**(53,358)**	**(52,518)**	**(51,604)**	**(50,613)**	**(49,544)**	
Interest Expense (Land)	(5,826)	(5,741)	(5,651)	(5,556)	(5,456)	(5,351)	(5,240)	(5,123)	(5,000)	(4,871)	(4,735)	(4,591)	(4,440)	(4,281)	(4,113)	
Pre-Tax Income	**(101,062)**	**(73,666)**	**(64,860)**	**(63,069)**	**(62,532)**	**(61,945)**	**(61,302)**	**(60,601)**	**(59,835)**	**(59,000)**	**(58,093)**	**(57,109)**	**(56,044)**	**(54,894)**	**(53,656)**	
Income Taxes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Net Income	**(101,062)**	**(73,666)**	**(64,860)**	**(63,069)**	**(62,532)**	**(61,945)**	**(61,302)**	**(60,601)**	**(59,835)**	**(59,000)**	**(58,093)**	**(57,109)**	**(56,044)**	**(54,894)**	**(53,656)**	
Revenue Growth Rate		1,239.1%	499.6%	20.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	Constant
Harvesting & Planting Cost Growth Rate		1,045.1%	196.6%	20.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	Decrease by
Processing Cost Growth Rate		1,045.1%	196.6%	20.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	Decrease by

Illustrative Maryland Commercial Miscanthus Production Cash Flow Statement (Agriculturally Marginal Land)

	Actual			Estimated	Projected											
Fiscal	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Projection I**
Net Income	(101,062)	(73,666)	(64,860)	(63,069)	(62,532)	(61,945)	(61,302)	(60,601)	(59,835)	(59,000)	(58,093)	(57,109)	(56,044)	(54,894)	(53,656)	
Cash Flow From Operating Activities																
Depreciation (Harvest & Planting Equipment)	8,833	8,833	8,833	8,833	8,833	8,833	8,833	8,833	8,833	8,833	8,833	8,833	8,833	8,833	8,833	
Depreciation (Processing Equipment)	37,633	37,633	37,633	37,633	37,633	37,633	37,633	37,633	37,633	37,633	37,633	37,633	37,633	37,633	37,633	
Depreciation (Transportation Equipment)	6,067	6,067	6,067	6,067	6,067	6,067	6,067	6,067	6,067	6,067	6,067	6,067	6,067	6,067	6,067	
Amortization (Land)	1,605	1,690	1,780	1,875	1,975	2,080	2,191	2,307	2,430	2,560	2,696	2,840	2,991	3,150	3,318	
Change in Working Capital	(27,225.00)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Operating Activities	**26,912.94**	**54,223.40**	**54,313.40**	**54,408.21**	**54,508.06**	**54,613.23**	**54,724.00**	**54,840.66**	**54,963.55**	**55,092.97**	**55,229.29**	**55,372.87**	**55,524.10**	**55,683.38**	**55,851.14**	
Cash Flow From Investing Activities																
Harvesting & Planting Equipment	(132,500)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Processing Equipment	(398,500)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Land Acquisition	(140,960)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Transportation Equipment	(91,000)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Investing Activities	**(762,960)**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow from Financing Activities																
Mortgage Loan	112,768	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Investing Activities	**112,768**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Net Change in Cash	**(724,342)**	**(19,442)**	**(10,547)**	**(8,661)**	**(8,024)**	**(7,331)**	**(6,578)**	**(5,760)**	**(4,871)**	**(3,907)**	**(2,864)**	**(1,736)**	**(520)**	**789**	**2,195**	

Scenario Two Revenue &
Best Case Expenses

Processing Equipment Depreciation Schedule

Item	Purchase Price	Installation	Useful Life	Annual Depreciation
Dryer	$ -	$ -	$ 15	$ -
Pellet Mill	-	-	15	-
Pellet Cooler	-	-	15	-
Miscellaneous Equipment	-	-	15	-
Annual Depreciation				$ -

Processing Cost Schedule ($ / Ton)

Drying	$ 7.84
Pelletizing	2.09
Packaging	1.37

Tons Produced

Year 1	9.66
Year 2	110.64
Year 3	328.20

Transportation Equipment Depreciation Schedule

Item	Purchase Price	Useful Life	Annual Depreciation
Loader	$ -	$ 15	$ -
Truck	-	15	-
Total			**$ -**

Harvesting and Planting Equipment Depreciation Schedule

Item	Purchase Price	Useful Life	Annual Depreciation
Forage Harvester	$ -	15	$ -
Potato Planter	-	15	-
Tractor	-	15	-
Total			**$ -**

Facility Information

	Hectares	Acres
Average MD Farm	64.75	160
MD Price Per Acre		$ -
Land Purchase Price		$ -
Marginal Land Price Per Acre		$ -
Land Acquisition Price		$ -
Price Per Miscanthus Rhizome		$ 2.25
Acres Per Hectare		2.4710538

Transportation Fixed Costs

Registration, Permits & Fees	$ 6,970
Insurance (Vehicle)	3,290
Insurance (Goods-in-Transit)	500
Insurance (Personal Sickness)	450
Insurance (Public Liability)	405
Insurance (Workers' Comp)	1,533
Total	**$ 13,148**

Transportation Variable Costs Per Mile

Fuel (3.872 Per Gallon)	$ 0.55
Tires	0.03
Servicing & Maintenance	0.12
Total	**$ 0.70**

Assumptions

Land Price (%)	0.0%
Subsidy Amount	100.0%
Equipment Purchased	0.0%
Equipment Owned	100.0%
Choose	10
Miscanthus Price	$ 160.07

GEMSTONE TEAM BIOFUELS

Illustrative Maryland Commercial Miscanthus Production Income Statement (Agriculturally Viable Land)

	Actual			Estimated	Projected											
Fiscal	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Projection M**
Revenue																
Miscanthus x. Giganteus Sales	$ 1,546	$ 17,709	$ 52,533	$ 63,040	$ 66,192	$ 69,501	$ 72,976	$ 76,625	$ 80,456	$ 84,479	$ 88,703	$ 93,138	$ 97,795	$ 102,685	$ 107,819	
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Revenue fron
Total Revenue	**$ 1,546**	**$ 17,709**	**$ 52,533**	**$ 63,040**	**$ 66,192**	**$ 69,501**	**$ 72,976**	**$ 76,625**	**$ 80,456**	**$ 84,479**	**$ 88,703**	**$ 93,138**	**$ 97,795**	**$ 102,685**	**$ 107,819**	
Cost of Production																
Harvesting & Planting	(123)	(1,410)	(4,181)	(5,017)	(5,268)	(5,532)	(5,808)	(6,099)	(6,404)	(6,724)	(7,060)	(7,413)	(7,784)	(8,173)	(8,582)	$12.74
Cost of Plants	(27,225)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Includes Dryi
Processing	(109)	(1,250)	(3,709)	(4,450)	(4,673)	(4,883)	(5,078)	(5,256)	(5,414)	(5,549)	(5,660)	(5,745)	(5,803)	(5,832)	(5,832)	
Transportation	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	Constant
Gross Profit	(39,762)	1,198	30,792	39,721	42,399	45,235	48,239	51,419	54,788	58,355	62,132	66,129	70,358	74,830	79,555	
Operating, SG&A Expenses																
Depreciation (Harvest & Planting Equipment)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Straight line
Depreciation (Processing Equipment)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Straight line
Depreciation (Transportation Equipment)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Straight line
Amortization (Land)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	See amortiza
Operating Income	**$ (39,762)**	**$ 1,198**	**$ 30,792**	**$ 39,721**	**$ 42,399**	**$ 45,235**	**$ 48,239**	**$ 51,419**	**$ 54,788**	**$ 58,355**	**$ 62,132**	**$ 66,129**	**$ 70,358**	**$ 74,830**	**$ 79,555**	
Interest Expense (Land)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Pre-Tax Income	**$ (39,762)**	**$ 1,198**	**$ 30,792**	**$ 39,721**	**$ 42,399**	**$ 45,235**	**$ 48,239**	**$ 51,419**	**$ 54,788**	**$ 58,355**	**$ 62,132**	**$ 66,129**	**$ 70,358**	**$ 74,830**	**$ 79,555**	
Income Taxes	-	359.5	9,237.7	11,916.3	12,719.8	13,570.6	14,471.6	15,425.8	16,436.3	17,506.5	18,639.6	19,838.7	21,107.4	22,448.9	23,866.5	
Net Income	**$ (39,762)**	**$ 1,558**	**$ 40,030**	**$ 51,637**	**$ 55,119**	**$ 58,806**	**$ 62,710**	**$ 66,845**	**$ 71,224**	**$ 75,862**	**$ 80,771**	**$ 85,968**	**$ 91,465**	**$ 97,278**	**$ 103,422**	
Revenue Growth Rate		1,045.1%	196.6%	20.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	Constant
Harvesting & Planting Cost Growth Rate		1,045.1%	196.6%	20.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	Decrease by
Processing Cost Growth Rate		1,045.1%	196.6%	20.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	Decrease by

Illustrative Maryland Commercial Miscanthus Production Cash Flow Statement (Agriculturally Viable Land)

	Actual			Estimated	Projected											
Fiscal	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Projection M**
Net Income	$ (39,762)	$ 1,558	$ 40,030	$ 51,637	$ 55,119	$ 58,806	$ 62,710	$ 66,845	$ 71,224	$ 75,862	$ 80,771	$ 85,968	$ 91,465	$ 97,278	$ 103,422	
Cash Flow From Operating Activities																
Depreciation (Harvest & Planting Equipment)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Depreciation (Processing Equipment)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Depreciation (Transportation Equipment)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Amortization (Land)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Change in Working Capital	(27,225)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Operating Activities	**$ (27,225)**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Cash Flow From Investing Activities																
Harvesting & Planting Equipment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Processing Equipment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Land Acquisition	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Transportation Equipment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Investing Activities	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Cash Flow from Financing Activities																
Mortgage Loan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash flow from Financing Activities	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Net Change in Cash	**$ (66,987)**	**$ 1,558**	**$ 40,030**	**$ 51,637**	**$ 55,119**	**$ 58,806**	**$ 62,710**	**$ 66,845**	**$ 71,224**	**$ 75,862**	**$ 80,771**	**$ 85,968**	**$ 91,465**	**$ 97,278**	**$ 103,422**	

GEMSTONE TEAM BIOFUELS

Illustrative Maryland Commercial Miscanthus Production Income Statement (Agriculturally Marginal Land)

	Actual			Estimated	Projected											
Fiscal	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Projection N**
Revenue																
Miscanthus x. Giganteus Sales	$ 209.78	$ 2,809.09	$ 16,844.49	$ 20,213.38	$ 21,224.05	$ 22,285.25	$ 23,399.52	$ 24,569.49	$ 25,797.97	$ 27,087.87	$ 28,442.26	$ 29,864.37	$ 31,357.59	$ 32,925.47	$ 34,571.74	
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Revenue fron
Total Revenue	**$ 209.78**	**$ 2,809.09**	**$ 16,844.49**	**$ 20,213.38**	**$ 21,224.05**	**$ 22,285.25**	**$ 23,399.52**	**$ 24,569.49**	**$ 25,797.97**	**$ 27,087.87**	**$ 28,442.26**	**$ 29,864.37**	**$ 31,357.59**	**$ 32,925.47**	**$ 34,571.74**	
Cost of Production																
Harvesting & Planting	(123)	(1,410)	(4,181)	(5,017)	(5,268)	(5,532)	(5,808)	(6,099)	(6,404)	(6,724)	(7,060)	(7,413)	(7,784)	(8,173)	(8,582)	$12.74
Cost of Plants	(27,225)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Includes Dryi
Processing	(109)	(1,250)	(3,709)	(4,450)	(4,673)	(4,883)	(5,078)	(5,256)	(5,414)	(5,549)	(5,660)	(5,745)	(5,803)	(5,832)	(5,832)	
Transportation	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	Constant
Gross Profit	(41,098)	(13,702)	(4,896)	(3,105)	(2,568)	(1,981)	(1,338)	(637)	129	964	1,871	2,855	3,920	5,070	6,308	
Operating, SG&A Expenses																
Depreciation (Harvest & Planting Equipment)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	Straight line
Depreciation (Processing Equipment)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Straight line
Depreciation (Transportation Equipment)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Straight line
Amortization (Land)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	See amortiza
Operating Income	**$ (41,098)**	**$ (13,702)**	**$ (4,896)**	**$ (3,105)**	**$ (2,568)**	**$ (1,981)**	**$ (1,338)**	**$ (637)**	**$ 129**	**$ 964**	**$ 1,871**	**$ 2,855**	**$ 3,920**	**$ 5,070**	**$ 6,308**	
Interest Expense (Land)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Pre-Tax Income	**$ (41,098)**	**$ (13,702)**	**$ (4,896)**	**$ (3,105)**	**$ (2,568)**	**$ (1,981)**	**$ (1,338)**	**$ (637)**	**$ 129**	**$ 964**	**$ 1,871**	**$ 2,855**	**$ 3,920**	**$ 5,070**	**$ 6,308**	
Income Taxes	-	-	-	-	-	-	-	-	39	289	561	857	1,176	1,521	1,892	
Net Income	**$ (41,098)**	**$ (13,702)**	**$ (4,896)**	**$ (3,105)**	**$ (2,568)**	**$ (1,981)**	**$ (1,338)**	**$ (637)**	**$ 168**	**$ 1,253**	**$ 2,432**	**$ 3,712**	**$ 5,096**	**$ 6,591**	**$ 8,200**	
Revenue Growth Rate		1,239.1%	499.6%	20.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	Constant
Harvesting & Planting Cost Growth Rate		1,045.1%	196.6%	20.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	Decrease by
Processing Cost Growth Rate		1,045.1%	196.6%	20.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	Decrease by

Illustrative Maryland Commercial Miscanthus Production Cash Flow Statement (Agriculturally Marginal Land)

	Actual			Estimated	Projected											
Fiscal	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Projection N**
Net Income	$ (41,098)	$ (13,702)	$ (4,896)	$ (3,105)	$ (2,568)	$ (1,981)	$ (1,338)	$ (637)	$ 168	$ 1,253	$ 2,432	$ 3,712	$ 5,096	$ 6,591	$ 8,200	
Cash Flow From Operating Activities																
Depreciation (Harvest & Planting Equipment)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Depreciation (Processing Equipment)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Depreciation (Transportation Equipment)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Amortization (Land)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Change in Working Capital	(27,225.00)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Operating Activities	**$ (27,225.00)**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Cash Flow From Investing Activities																
Harvesting & Planting Equipment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
Processing Equipment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Land Acquisition	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Transportation Equipment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Investing Activities	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Cash Flow from Financing Activities																
Mortgage Loan	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
Cash Flow From Investing Activities	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Net Change in Cash	**$ (68,323)**	**$ (13,702)**	**$ (4,896)**	**$ (3,105)**	**$ (2,568)**	**$ (1,981)**	**$ (1,338)**	**$ (637)**	**$ 168**	**$ 1,253**	**$ 2,432**	**$ 3,712**	**$ 5,096**	**$ 6,591**	**$ 8,200**	

Scenario Three Revenue & Worst Case Expenses

Processing Equipment Depreciation Schedule

Item	Purchase Price	Installation	Useful Life	Annual Depreciation
Dryer	$ 350,000	$ 71,000	$ 15	$ 28,067
Pellet Mill	315,000	71,000	15	25,733
Pellet Cooler	32,000	24,000	15	3,733
Miscellaneous Equipment	100,000	-	15	6,667
Annual Depreciation				$ 64,200

Processing Cost Schedule ($ / Ton)

Drying	$ 7.84
Pelletizing	2.09
Packaging	1.37

Tons Produced

Year 1	9.66
Year 2	110.64
Year 3	328.20

Transportation Equipment Depreciation Schedule

Item	Purchase Price	Useful Life	Annual Depreciation
Loader	$ 82,000	$ 15	$ 5,467
Truck	100,000	15	6,667
Total			**$ 12,133**

Harvesting and Planting Equipment Depreciation Schedule

Item	Purchase Price	Useful Life	Annual Depreciation
Forage Harvester	$ 29,000	15	$ 1,933.33
Potato Planter	86,000	15	5,733.33
Tractor	150,000	15	10,000.00
Total			**$ 17,666.67**

Facility Information

	Hectares	Acres
Average MD Farm	64.75	160
MD Price Per Acre		$ 7,000
Land Purchase Price		$ 1,120,000
Marginal Land Price Per Acre		$ 1,762
Land Acquisition Price		$ 281,920
Price Per Miscanthus Rhizome		$ 2.25
Acres Per Hectare		2.4710538

Transportation Fixed Costs

Registration, Permits & Fees	$ 6,970
Insurance (Vehicle)	3,290
Insurance (Goods-in-Transit)	500
Insurance (Personal Sickness)	450
Insurance (Public Liability)	405
Insurance (Workers' Comp)	1,533
Total	**$ 13,148**

Transportation Variable Costs Per Mile

Fuel (3.872 Per Gallon)	$ 0.55
Tires	0.03
Servicing & Maintenance	0.12
Total	**$ 0.70**

Assumptions

Land Price (%)	100.0%
Subsidy Amount	0.0%
Equipment Purchased	100.0%
Equipment Owned	0.0%
Choose	11
Miscanthus Price	$ 240.10

GEMSTONE TEAM BIOFUELS

Illustrative Maryland Commercial Miscanthus Production Income Statement (Agriculturally Viable Land)

	Actual			Estimated	Projected											
Fiscal	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Projection N**
Revenue																
Miscanthus x. Giganteus Sales	$ 2,320	$ 26,564	$ 78,800	$ 94,560	$ 99,288	$ 104,252	$ 109,465	$ 114,938	$ 120,685	$ 126,719	$ 133,055	$ 139,708	$ 146,693	$ 154,028	$ 161,729	
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Revenue fron
Total Revenue	**$ 2,320**	**$ 26,564**	**$ 78,800**	**$ 94,560**	**$ 99,288**	**$ 104,252**	**$ 109,465**	**$ 114,938**	**$ 120,685**	**$ 126,719**	**$ 133,055**	**$ 139,708**	**$ 146,693**	**$ 154,028**	**$ 161,729**	
Cost of Production																
Harvesting & Planting	(123)	(1,410)	(4,181)	(5,017)	(5,268)	(5,532)	(5,808)	(6,099)	(6,404)	(6,724)	(7,060)	(7,413)	(7,784)	(8,173)	(8,582)	$12.74
Cost of Plants	(27,225)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Includes Dryi
Processing	(109)	(1,250)	(3,709)	(4,450)	(4,673)	(4,883)	(5,078)	(5,256)	(5,414)	(5,549)	(5,660)	(5,745)	(5,803)	(5,832)	(5,832)	
Transportation	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	Constant
Gross Profit	(38,989)	10,053	57,059	71,241	75,495	79,986	84,727	89,732	95,016	100,595	106,484	112,698	119,256	126,172	133,465	
Operating, SG&A Expenses																
Depreciation (Harvest & Planting Equipment)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	(17,667)	Straight line
Depreciation (Processing Equipment)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	Straight line
Depreciation (Transportation Equipment)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	Straight line
Amortization (Land)	(12,749)	(13,428)	(14,144)	(14,897)	(15,690)	(16,526)	(17,406)	(18,333)	(19,309)	(20,338)	(21,421)	(22,562)	(23,763)	(25,029)	(26,362)	See amortiza
Operating Income	**$ (145,738)**	**$ (97,375)**	**$ (51,085)**	**$ (37,656)**	**$ (34,195)**	**$ (30,540)**	**$ (26,679)**	**$ (22,601)**	**$ (18,293)**	**$ (13,743)**	**$ (8,937)**	**$ (3,863)**	**$ 1,492**	**$ 7,143**	**$ 13,103**	
Interest Expense (Land)	(46,291)	(45,612)	(44,897)	(44,144)	(43,350)	(42,515)	(41,634)	(40,707)	(39,731)	(38,703)	(36,479)	(36,479)	(35,277)	(34,012)	(32,679)	
Pre-Tax Income	**$ (192,029)**	**$ (142,987)**	**$ (95,982)**	**$ (81,800)**	**$ (77,545)**	**$ (73,054)**	**$ (68,314)**	**$ (63,309)**	**$ (58,024)**	**$ (52,446)**	**$ (45,416)**	**$ (40,342)**	**$ (33,785)**	**$ (26,868)**	**$ (19,576)**	
Income Taxes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Net Income	**$ (192,029)**	**$ (142,987)**	**$ (95,982)**	**$ (81,800)**	**$ (77,545)**	**$ (73,054)**	**$ (68,314)**	**$ (63,309)**	**$ (58,024)**	**$ (52,446)**	**$ (45,416)**	**$ (40,342)**	**$ (33,785)**	**$ (26,868)**	**$ (19,576)**	
Revenue Growth Rate		1,045.1%	196.6%	20.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	Constant
Harvesting & Planting Cost Growth Rate		1,045.1%	196.6%	20.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	Decrease by
Processing Cost Growth Rate		1,045.1%	196.6%	20.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	Decrease by

Illustrative Maryland Commercial Miscanthus Production Cash Flow Statement (Agriculturally Viable Land)

	Actual			Estimated	Projected											
Fiscal	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Projection N**
Net Income	$ (192,029)	$ (142,987)	$ (95,982)	$ (81,800)	$ (77,545)	$ (73,054)	$ (68,314)	$ (63,309)	$ (58,024)	$ (52,446)	$ (45,416)	$ (40,342)	$ (33,785)	$ (26,868)	$ (19,576)	
Cash Flow From Operating Activities																
Depreciation (Harvest & Planting Equipment)	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	
Depreciation (Processing Equipment)	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	
Depreciation (Transportation Equipment)	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	
Amortization (Land)	12,749	13,428	14,144	14,897	15,690	16,526	17,406	18,333	19,309	20,338	21,421	22,562	23,763	25,029	26,362	
Change in Working Capital	(27,225)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Operating Activities	**$ 79,524**	**$ 107,428**	**$ 108,144**	**$ 108,897**	**$ 109,690**	**$ 110,526**	**$ 111,406**	**$ 112,333**	**$ 113,309**	**$ 114,338**	**$ 115,421**	**$ 116,562**	**$ 117,763**	**$ 119,029**	**$ 120,362**	
Cash Flow From Investing Activities																
Harvesting & Planting Equipment	(265,000)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Processing Equipment	(797,000)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Land Acquisition	(1,120,000)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Transportation Equipment	(182,000)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Investing Activities	**$ (2,364,000)**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Cash Flow from Financing Activities																
Mortgage Loan	896,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash flow from Financing Activities	**$ 896,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Net Change in Cash	**$ (1,580,505)**	**$ (35,559)**	**$ 12,162**	**$ 27,097**	**$ 32,145**	**$ 37,471**	**$ 43,092**	**$ 49,024**	**$ 55,285**	**$ 61,892**	**$ 70,005**	**$ 76,220**	**$ 83,978**	**$ 92,160**	**$ 100,786**	

GEMSTONE TEAM BIOFUELS

Illustrative Maryland Commercial Miscanthus Production Income Statement (Agriculturally Marginal Land)

	Actual			Estimated	Projected											
Fiscal	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Projection N**
Revenue																
Miscanthus x. Giganteus Sales	$ 314.67	$ 4,213.63	$ 25,266.73	$ 30,320.07	$ 31,836.08	$ 33,427.88	$ 35,099.28	$ 36,854.24	$ 38,696.95	$ 40,631.80	$ 42,663.39	$ 44,796.56	$ 47,036.39	$ 49,388.21	$ 51,857.62	
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Revenue fron
Total Revenue	**$ 314.67**	**$ 4,213.63**	**$ 25,266.73**	**$ 30,320.07**	**$ 31,836.08**	**$ 33,427.88**	**$ 35,099.28**	**$ 36,854.24**	**$ 38,696.95**	**$ 40,631.80**	**$ 42,663.39**	**$ 44,796.56**	**$ 47,036.39**	**$ 49,388.21**	**$ 51,857.62**	
Cost of Production																
Harvesting & Planting	(123)	(1,410)	(4,181)	(5,017)	(5,268)	(5,532)	(5,808)	(6,099)	(6,404)	(6,724)	(7,060)	(7,413)	(7,784)	(8,173)	(8,582)	$12.74
Cost of Plants	(27,225)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Includes Dryi
Processing	(109)	(1,250)	(3,709)	(4,450)	(4,673)	(4,883)	(5,078)	(5,256)	(5,414)	(5,549)	(5,660)	(5,745)	(5,803)	(5,832)	(5,832)	
Transportation	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	Constant
Gross Profit	(40,994)	(12,297)	3,526	7,001	8,044	9,162	10,361	11,648	13,028	14,508	16,092	17,787	19,599	21,533	23,593	
Operating, SG&A Expenses																
Depreciation (Harvest & Planting Equipment)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	$ (17,666.67)	Straight line
Depreciation (Processing Equipment)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	(64,200)	Straight line
Depreciation (Transportation Equipment)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	(12,133)	Straight line
Amortization (Land)	(3,209)	(3,380)	(3,560)	(3,750)	(3,949)	(4,160)	(4,381)	(4,615)	(4,860)	(5,119)	(5,392)	(5,679)	(5,982)	(6,300)	(6,636)	See amortiza
Operating Income	**$ (138,203)**	**$ (109,677)**	**$ (94,034)**	**$ (90,749)**	**$ (89,906)**	**$ (88,998)**	**$ (88,020)**	**$ (86,966)**	**$ (85,832)**	**$ (84,612)**	**$ (83,300)**	**$ (81,892)**	**$ (80,383)**	**$ (78,767)**	**$ (77,042)**	
Interest Expense (Land)	(11,652)	(11,481)	(11,301)	(11,112)	(10,912)	(10,702)	(10,480)	(10,247)	(10,001)	(9,742)	(9,469)	(9,182)	(8,880)	(8,561)	(8,226)	
Pre-Tax Income	**$ (149,855)**	**$ (121,158)**	**$ (105,335)**	**$ (101,860)**	**$ (100,817)**	**$ (99,699)**	**$ (98,500)**	**$ (97,213)**	**$ (95,833)**	**$ (94,354)**	**$ (92,769)**	**$ (91,074)**	**$ (89,262)**	**$ (87,329)**	**$ (85,268)**	
Income Taxes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Net Income	**$ (149,855)**	**$ (121,158)**	**$ (105,335)**	**$ (101,860)**	**$ (100,817)**	**$ (99,699)**	**$ (98,500)**	**$ (97,213)**	**$ (95,833)**	**$ (94,354)**	**$ (92,769)**	**$ (91,074)**	**$ (89,262)**	**$ (87,329)**	**$ (85,268)**	
Revenue Growth Rate		1,239.1%	499.6%	20.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	Constant
Harvesting & Planting Cost Growth Rate		1,045.1%	196.6%	20.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	Decrease by
Processing Cost Growth Rate		1,045.1%	196.6%	20.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	Decrease by

Illustrative Maryland Commercial Miscanthus Production Cash Flow Statement (Agriculturally Marginal Land)

	Actual			Estimated	Projected											
Fiscal	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Projection N**
Net Income	$ (149,855)	$ (121,158)	$ (105,335)	$ (101,860)	$ (100,817)	$ (99,699)	$ (98,500)	$ (97,213)	$ (95,833)	$ (94,354)	$ (92,769)	$ (91,074)	$ (89,262)	$ (87,329)	$ (85,268)	
Cash Flow From Operating Activities																
Depreciation (Harvest & Planting Equipment)	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	17,667	
Depreciation (Processing Equipment)	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	64,200	
Depreciation (Transportation Equipment)	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	12,133	
Amortization (Land)	3,209	3,380	3,560	3,750	3,949	4,160	4,381	4,615	4,860	5,119	5,392	5,679	5,982	6,300	6,636	
Change in Working Capital	(27,225.00)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Operating Activities	**$ 69,984.21**	**$ 97,380.12**	**$ 97,560.14**	**$ 97,749.75**	**$ 97,949.45**	**$ 98,159.78**	**$ 98,381.32**	**$ 98,614.66**	**$ 98,860.43**	**$ 99,119.28**	**$ 99,391.92**	**$ 99,679.08**	**$ 99,981.53**	**$ 100,300.09**	**$ 100,635.62**	
Cash Flow From Investing Activities																
Harvesting & Planting Equipment	$ (265,000)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
Processing Equipment	(797,000)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Land Acquisition	(281,920)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Transportation Equipment	(182,000)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Investing Activities	**$ (1,525,920)**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Cash Flow from Financing Activities																
Mortgage Loan	$ 225,536	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
Cash Flow From Investing Activities	**$ 225,536**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Net Change in Cash	**$ (1,380,255)**	**$ (23,778)**	**$ (7,775)**	**$ (4,110)**	**$ (2,868)**	**$ (1,540)**	**$ (119)**	**$ 1,402**	**$ 3,027**	**$ 4,766**	**$ 6,623**	**$ 8,605**	**$ 10,719**	**$ 12,971**	**$ 15,368**	

Processing Equipment Depreciation Schedule

Item	Purchase Price	Installation	Useful Life	Annual Depreciation
Dryer	$ 175,000	$ 71,000	$ 15	$ 16,400
Pellet Mill	157,500	71,000	15	15,233
Pellet Cooler	16,000	24,000	15	2,667
Miscellaneous Equipment	50,000	-	15	3,333
Annual Depreciation				$ 37,633

Processing Cost Schedule ($ / Ton)

Drying	$ 7.84
Pelletizing	2.09
Packaging	1.37

Tons Produced

Year 1	9.66
Year 2	110.64
Year 3	328.20

Transportation Equipment Depreciation Schedule

Item	Purchase Price	Useful Life	Annual Depreciation
Loader	$ 41,000	$ 15	$ 2,733
Truck	50,000	15	3,333
Total			**$ 6,067**

Harvesting and Planting Equipment Depreciation Schedule

Item	Purchase Price	Useful Life	Annual Depreciation
Forage Harvester	$ 14,500	15	$ 966.67
Potato Planter	43,000	15	2,866.67
Tractor	75,000	15	5,000.00
Total			**$ 8,833.33**

Facility Information

	Hectares	Acres
Average MD Farm	64.75	160
MD Price Per Acre		$ 3,500
Land Purchase Price		$ 560,000
Marginal Land Price Per Acre		$ 881
Land Acquisition Price		$ 140,960
Price Per Miscanthus Rhizome		$ 2.25
Acres Per Hectare		2.4710538

Transportation Fixed Costs

Registration, Permits & Fees	$ 6,970
Insurance (Vehicle)	3,290
Insurance (Goods-in-Transit)	500
Insurance (Personal Sickness)	450
Insurance (Public Liability)	405
Insurance (Workers' Comp)	1,533
Total	**$ 13,148**

Transportation Variable Costs Per Mile

Fuel (3.872 Per Gallon)	$ 0.55
Tires	0.03
Servicing & Maintenance	0.12
Total	**$ 0.70**

Assumptions

Land Price (%)	**50.0%**
Subsidy Amount	50.0%
Equipment Purchased	**50.0%**
Equipment Owned	50.0%
Choose	**11**
Miscanthus Price	$ 240.10

Scenario Three Revenue &
Base Case Expenses

GEMSTONE TEAM BIOFUELS

Illustrative Maryland Commercial Miscanthus Production Income Statement (Agriculturally Viable Land)

	Actual			Estimated	Projected											
Fiscal	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Projection N**
Revenue																
Miscanthus x. Giganteus Sales	$ 2,320	$ 26,564	$ 78,800	$ 94,560	$ 99,288	$ 104,252	$ 109,465	$ 114,938	$ 120,685	$ 126,719	$ 133,055	$ 139,708	$ 146,693	$ 154,028	$ 161,729	
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Revenue fron
Total Revenue	**$ 2,320**	**$ 26,564**	**$ 78,800**	**$ 94,560**	**$ 99,288**	**$ 104,252**	**$ 109,465**	**$ 114,938**	**$ 120,685**	**$ 126,719**	**$ 133,055**	**$ 139,708**	**$ 146,693**	**$ 154,028**	**$ 161,729**	
Cost of Production																
Harvesting & Planting	(123)	(1,410)	(4,181)	(5,017)	(5,268)	(5,532)	(5,808)	(6,099)	(6,404)	(6,724)	(7,060)	(7,413)	(7,784)	(8,173)	(8,582)	$12.74
Cost of Plants	(27,225)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Includes Dryi
Processing	(109)	(1,250)	(3,709)	(4,450)	(4,673)	(4,883)	(5,078)	(5,256)	(5,414)	(5,549)	(5,660)	(5,745)	(5,803)	(5,832)	(5,832)	
Transportation	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	Constant
Gross Profit	(38,989)	10,053	57,059	71,241	75,495	79,986	84,727	89,732	95,016	100,595	106,484	112,698	119,256	126,172	133,465	
Operating, SG&A Expenses																
Depreciation (Harvest & Planting Equipment)	(8,833)	(8,833)	(8,833)	(8,833)	(8,833)	(8,833)	(8,833)	(8,833)	(8,833)	(8,833)	(8,833)	(8,833)	(8,833)	(8,833)	(8,833)	Straight line
Depreciation (Processing Equipment)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	Straight line
Depreciation (Transportation Equipment)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	Straight line
Amortization (Land)	(6,375)	(6,714)	(7,072)	(7,448)	(7,845)	(8,263)	(8,703)	(9,166)	(9,655)	(10,169)	(10,710)	(11,281)	(11,882)	(12,514)	(13,181)	See amortiza
Operating Income	**$ (97,897)**	**$ (49,195)**	**$ (2,546)**	**$ 11,259**	**$ 15,117**	**$ 19,190**	**$ 23,490**	**$ 28,032**	**$ 32,828**	**$ 37,893**	**$ 43,240**	**$ 48,884**	**$ 54,841**	**$ 61,124**	**$ 67,751**	
Interest Expense (Land)	(23,145)	(22,806)	(22,448)	(22,072)	(21,675)	(21,257)	(20,817)	(20,354)	(19,866)	(19,351)	(18,239)	(18,239)	(17,639)	(17,006)	(16,339)	
Pre-Tax Income	**$ (121,042)**	**$ (72,001)**	**$ (24,995)**	**$ (10,813)**	**$ (6,558)**	**$ (2,067)**	**$ 2,673**	**$ 7,678**	**$ 12,963**	**$ 18,541**	**$ 25,000**	**$ 30,645**	**$ 37,202**	**$ 44,119**	**$ 51,411**	
Income Taxes	-	-	-	-	-	-	802.0	2,303.5	3,888.8	5,562.4	7,500.1	9,193.4	11,160.6	13,235.6	15,423.4	
Net Income	**$ (121,042)**	**$ (72,001)**	**$ (24,995)**	**$ (10,813)**	**$ (6,558)**	**$ (2,067)**	**$ 3,475**	**$ 9,982**	**$ 16,851**	**$ 24,104**	**$ 32,501**	**$ 39,838**	**$ 48,363**	**$ 57,354**	**$ 66,835**	
Revenue Growth Rate		1,045.1%	196.6%	20.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	Constant
Harvesting & Planting Cost Growth Rate		1,045.1%	196.6%	20.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	Decrease by
Processing Cost Growth Rate		1,045.1%	196.6%	20.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	Decrease by

Illustrative Maryland Commercial Miscanthus Production Cash Flow Statement (Agriculturally Viable Land)

	Actual			Estimated	Projected											
Fiscal	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Projection N**
Net Income	$ (121,042)	$ (72,001)	$ (24,995)	$ (10,813)	$ (6,558)	$ (2,067)	$ 3,475	$ 9,982	$ 16,851	$ 24,104	$ 32,501	$ 39,838	$ 48,363	$ 57,354	$ 66,835	
Cash Flow From Operating Activities																
Depreciation (Harvest & Planting Equipment)	8,833	8,833	8,833	8,833	8,833	8,833	8,833	8,833	8,833	8,833	8,833	8,833	8,833	8,833	8,833	
Depreciation (Processing Equipment)	37,633	37,633	37,633	37,633	37,633	37,633	37,633	37,633	37,633	37,633	37,633	37,633	37,633	37,633	37,633	
Depreciation (Transportation Equipment)	6,067	6,067	6,067	6,067	6,067	6,067	6,067	6,067	6,067	6,067	6,067	6,067	6,067	6,067	6,067	
Amortization (Land)	6,375	6,714	7,072	7,448	7,845	8,263	8,703	9,166	9,655	10,169	10,710	11,281	11,882	12,514	13,181	
Change in Working Capital	(27,225)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Operating Activities	**$ 31,683**	**$ 59,248**	**$ 59,605**	**$ 59,982**	**$ 60,378**	**$ 60,796**	**$ 61,236**	**$ 61,700**	**$ 62,188**	**$ 62,702**	**$ 63,244**	**$ 63,814**	**$ 64,415**	**$ 65,048**	**$ 65,714**	
Cash Flow From Investing Activities																
Harvesting & Planting Equipment	(132,500)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Processing Equipment	(398,500)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Land Acquisition	(560,000)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Transportation Equipment	(91,000)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Investing Activities	**$ (1,182,000)**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Cash Flow from Financing Activities																
Mortgage Loan	448,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash flow from Financing Activities	**$ 448,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Net Change in Cash	**$ (823,359)**	**$ (12,753)**	**$ 34,610**	**$ 49,169**	**$ 53,820**	**$ 58,729**	**$ 64,711**	**$ 71,682**	**$ 79,039**	**$ 86,806**	**$ 95,744**	**$ 103,652**	**$ 112,778**	**$ 122,402**	**$ 132,549**	

GEMSTONE TEAM BIOFUELS

Illustrative Maryland Commercial Miscanthus Production Income Statement (Agriculturally Marginal Land)

	Actual			Estimated	Projected											
Fiscal	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Projection N**
Revenue																
Miscanthus x. Giganteus Sales	$ 314.67	$ 4,213.63	$ 25,266.73	$ 30,320.07	$ 31,836.08	$ 33,427.88	$ 35,099.28	$ 36,854.24	$ 38,696.95	$ 40,631.80	$ 42,663.39	$ 44,796.56	$ 47,036.39	$ 49,388.21	$ 51,857.62	
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Revenue fron
Total Revenue	**$ 314.67**	**$ 4,213.63**	**$ 25,266.73**	**$ 30,320.07**	**$ 31,836.08**	**$ 33,427.88**	**$ 35,099.28**	**$ 36,854.24**	**$ 38,696.95**	**$ 40,631.80**	**$ 42,663.39**	**$ 44,796.56**	**$ 47,036.39**	**$ 49,388.21**	**$ 51,857.62**	
Cost of Production																
Harvesting & Planting	(123)	(1,410)	(4,181)	(5,017)	(5,268)	(5,532)	(5,808)	(6,099)	(6,404)	(6,724)	(7,060)	(7,413)	(7,784)	(8,173)	(8,582)	$12.74
Cost of Plants	(27,225)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Includes Dryi
Processing	(109)	(1,250)	(3,709)	(4,450)	(4,673)	(4,883)	(5,078)	(5,256)	(5,414)	(5,549)	(5,660)	(5,745)	(5,803)	(5,832)	(5,832)	
Transportation	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	Constant
Gross Profit	(40,994)	(12,297)	3,526	7,001	8,044	9,162	10,361	11,648	13,028	14,508	16,092	17,787	19,599	21,533	23,593	
Operating, SG&A Expenses																
Depreciation (Harvest & Planting Equipment)	$ (8,833.33)	$ (8,833.33)	$ (8,833.33)	$ (8,833.33)	$ (8,833.33)	$ (8,833.33)	$ (8,833.33)	$ (8,833.33)	$ (8,833.33)	$ (8,833.33)	$ (8,833.33)	$ (8,833.33)	$ (8,833.33)	$ (8,833.33)	$ (8,833.33)	Straight line
Depreciation (Processing Equipment)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	(37,633)	Straight line
Depreciation (Transportation Equipment)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	(6,067)	Straight line
Amortization (Land)	(1,605)	(1,690)	(1,780)	(1,875)	(1,975)	(2,080)	(2,191)	(2,307)	(2,430)	(2,560)	(2,696)	(2,840)	(2,991)	(3,150)	(3,318)	See amortiza
Operating Income	**$ (95,132)**	**$ (66,520)**	**$ (50,788)**	**$ (47,407)**	**$ (46,464)**	**$ (45,451)**	**$ (44,363)**	**$ (43,192)**	**$ (41,935)**	**$ (40,585)**	**$ (39,137)**	**$ (37,586)**	**$ (35,925)**	**$ (34,151)**	**$ (32,258)**	
Interest Expense (Land)	(5,826)	(5,741)	(5,651)	(5,556)	(5,456)	(5,351)	(5,240)	(5,123)	(5,000)	(4,871)	(4,735)	(4,591)	(4,440)	(4,281)	(4,113)	
Pre-Tax Income	**$ (100,958)**	**$ (72,261)**	**$ (56,438)**	**$ (52,963)**	**$ (51,920)**	**$ (50,802)**	**$ (49,603)**	**$ (48,316)**	**$ (46,936)**	**$ (45,456)**	**$ (43,872)**	**$ (42,177)**	**$ (40,365)**	**$ (38,431)**	**$ (36,371)**	
Income Taxes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Net Income	**$ (100,958)**	**$ (72,261)**	**$ (56,438)**	**$ (52,963)**	**$ (51,920)**	**$ (50,802)**	**$ (49,603)**	**$ (48,316)**	**$ (46,936)**	**$ (45,456)**	**$ (43,872)**	**$ (42,177)**	**$ (40,365)**	**$ (38,431)**	**$ (36,371)**	
Revenue Growth Rate		1,239.1%	499.6%	20.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	Constant
Harvesting & Planting Cost Growth Rate		1,045.1%	196.6%	20.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	Decrease by
Processing Cost Growth Rate		1,045.1%	196.6%	20.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	Decrease by

Illustrative Maryland Commercial Miscanthus Production Cash Flow Statement (Agriculturally Marginal Land)

	Actual			Estimated	Projected											
Fiscal	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Projection N**
Net Income	$ (100,958)	$ (72,261)	$ (56,438)	$ (52,963)	$ (51,920)	$ (50,802)	$ (49,603)	$ (48,316)	$ (46,936)	$ (45,456)	$ (43,872)	$ (42,177)	$ (40,365)	$ (38,431)	$ (36,371)	
Cash Flow From Operating Activities																
Depreciation (Harvest & Planting Equipment)	8,833	8,833	8,833	8,833	8,833	8,833	8,833	8,833	8,833	8,833	8,833	8,833	8,833	8,833	8,833	
Depreciation (Processing Equipment)	37,633	37,633	37,633	37,633	37,633	37,633	37,633	37,633	37,633	37,633	37,633	37,633	37,633	37,633	37,633	
Depreciation (Transportation Equipment)	6,067	6,067	6,067	6,067	6,067	6,067	6,067	6,067	6,067	6,067	6,067	6,067	6,067	6,067	6,067	
Amortization (Land)	1,605	1,690	1,780	1,875	1,975	2,080	2,191	2,307	2,430	2,560	2,696	2,840	2,991	3,150	3,318	
Change in Working Capital	(27,225.00)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Operating Activities	**$ 26,912.94**	**$ 54,223.40**	**$ 54,313.40**	**$ 54,408.21**	**$ 54,508.06**	**$ 54,613.23**	**$ 54,724.00**	**$ 54,840.66**	**$ 54,963.55**	**$ 55,092.97**	**$ 55,229.29**	**$ 55,372.87**	**$ 55,524.10**	**$ 55,683.38**	**$ 55,851.14**	
Cash Flow From Investing Activities																
Harvesting & Planting Equipment	$ (132,500)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
Processing Equipment	(398,500)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Land Acquisition	(140,960)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Transportation Equipment	(91,000)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Investing Activities	**$ (762,960)**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Cash Flow from Financing Activities																
Mortgage Loan	$ 112,768	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
Cash Flow From Investing Activities	**$ 112,768**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Net Change in Cash	**$ (724,237)**	**$ (18,038)**	**$ (2,125)**	**$ 1,445**	**$ 2,588**	**$ 3,811**	**$ 5,121**	**$ 6,525**	**$ 8,028**	**$ 9,637**	**$ 11,357**	**$ 13,196**	**$ 15,159**	**$ 17,252**	**$ 19,481**	

Scenario Three Revenue & Best Case Expenses

Processing Equipment Depreciation Schedule

Item	Purchase Price	Installation	Useful Life	Annual Depreciation
Dryer	$ -	$ -	$ 15	$ -
Pellet Mill	-	-	15	-
Pellet Cooler	-	-	15	-
Miscellaneous Equipment	-	-	15	-
Annual Depreciation				$ -

Processing Cost Schedule ($ / Ton)

Drying	$ 7.84
Pelletizing	2.09
Packaging	1.37

Tons Produced

Year 1	9.66
Year 2	110.64
Year 3	328.20

Transportation Equipment Depreciation Schedule

Item	Purchase Price	Useful Life	Annual Depreciation
Loader	$ -	$ 15	$ -
Truck	-	15	-
Total			**$ -**

Harvesting and Planting Equipment Depreciation Schedule

Item	Purchase Price	Useful Life	Annual Depreciation
Forage Harvester	$ -	15	$ -
Potato Planter	-	15	-
Tractor	-	15	-
Total			**$ -**

Facility Information

	Hectares	Acres
Average MD Farm	64.75	160
MD Price Per Acre		$ -
Land Purchase Price		$ -
Marginal Land Price Per Acre		$ -
Land Acquisition Price		$ -
Price Per Miscanthus Rhizome		$ 2.25
Acres Per Hectare		2.4710538

Transportation Fixed Costs

Registration, Permits & Fees	$ 6,970
Insurance (Vehicle)	3,290
Insurance (Goods-in-Transit)	500
Insurance (Personal Sickness)	450
Insurance (Public Liability)	405
Insurance (Workers' Comp)	1,533
Total	**$ 13,148**

Transportation Variable Costs Per Mile

Fuel (3.872 Per Gallon)	$ 0.55
Tires	0.03
Servicing & Maintenance	0.12
Total	**$ 0.70**

Assumptions

Land Price (%)	0.0%
Subsidy Amount	100.0%
Equipment Purchased	0.0%
Equipment Owned	100.0%
Choose	11
Miscanthus Price	$ 240.10

GEMSTONE TEAM BIOFUELS

Illustrative Maryland Commercial Miscanthus Production Income Statement (Agriculturally Viable Land)

	Actual			Estimated						Projected						
Fiscal	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Projection N**
Revenue																
Miscanthus x. Giganteus Sales	2,320	26,564	78,800	94,560	99,288	104,252	109,465	114,938	120,685	126,719	133,055	139,708	146,693	154,028	161,729	
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Revenue fron
Total Revenue	**2,320**	**26,564**	**78,800**	**94,560**	**99,288**	**104,252**	**109,465**	**114,938**	**120,685**	**126,719**	**133,055**	**139,708**	**146,693**	**154,028**	**161,729**	
Cost of Production																
Harvesting & Planting	(123)	(1,410)	(4,181)	(5,017)	(5,268)	(5,532)	(5,808)	(6,099)	(6,404)	(6,724)	(7,060)	(7,413)	(7,784)	(8,173)	(8,582)	$12.74
Cost of Plants	(27,225)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Includes Dryi
Processing	(109)	(1,250)	(3,709)	(4,450)	(4,673)	(4,883)	(5,078)	(5,256)	(5,414)	(5,549)	(5,660)	(5,745)	(5,803)	(5,832)	(5,832)	
Transportation	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	Constant
Gross Profit	(38,989)	10,053	57,059	71,241	75,495	79,986	84,727	89,732	95,016	100,595	106,484	112,698	119,256	126,172	133,465	
Operating, SG&A Expenses																
Depreciation (Harvest & Planting Equipment)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Straight line
Depreciation (Processing Equipment)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Straight line
Depreciation (Transportation Equipment)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Straight line
Amortization (Land)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	See amortiza
Operating Income	**(38,989)**	**10,053**	**57,059**	**71,241**	**75,495**	**79,986**	**84,727**	**89,732**	**95,016**	**100,595**	**106,484**	**112,698**	**119,256**	**126,172**	**133,465**	
Interest Expense (Land)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Pre-Tax Income	**(38,989)**	**10,053**	**57,059**	**71,241**	**75,495**	**79,986**	**84,727**	**89,732**	**95,016**	**100,595**	**106,484**	**112,698**	**119,256**	**126,172**	**133,465**	
Income Taxes	-	3,015.9	17,117.6	21,372.2	22,648.6	23,995.8	25,418.0	26,919.5	28,504.8	30,178.4	31,945.1	33,809.5	35,776.7	37,851.6	40,039.4	
Net Income	**(38,989)**	**13,069**	**74,176**	**92,613**	**98,144**	**103,982**	**110,145**	**116,651**	**123,521**	**130,773**	**138,429**	**146,508**	**155,032**	**164,024**	**173,504**	
Revenue Growth Rate		1,045.1%	196.6%	20.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	Constant
Harvesting & Planting Cost Growth Rate		1,045.1%	196.6%	20.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	Decrease by
Processing Cost Growth Rate		1,045.1%	196.6%	20.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	Decrease by

Illustrative Maryland Commercial Miscanthus Production Cash Flow Statement (Agriculturally Viable Land)

	Actual			Estimated						Projected						
Fiscal	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Projection N**
Net Income	(38,989)	13,069	74,176	92,613	98,144	103,982	110,145	116,651	123,521	130,773	138,429	146,508	155,032	164,024	173,504	
Cash Flow From Operating Activities																
Depreciation (Harvest & Planting Equipment)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Depreciation (Processing Equipment)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Depreciation (Transportation Equipment)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Amortization (Land)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Change in Working Capital	(27,225)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Operating Activities	**(27,225)**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	
Cash Flow From Investing Activities																
Harvesting & Planting Equipment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Processing Equipment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Land Acquisition	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Transportation Equipment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Investing Activities	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	
Cash Flow from Financing Activities																
Mortgage Loan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash flow from Financing Activities	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	
Net Change in Cash	**(66,214)**	**13,069**	**74,176**	**92,613**	**98,144**	**103,982**	**110,145**	**116,651**	**123,521**	**130,773**	**138,429**	**146,508**	**155,032**	**164,024**	**173,504**	

GEMSTONE TEAM BIOFUELS

Illustrative Maryland Commercial Miscanthus Production Income Statement (Agriculturally Marginal Land)

	Actual			Estimated	Projected											
Fiscal	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Projection I**
Revenue																
Miscanthus x. Giganteus Sales	$ 314.67	$ 4,213.63	$ 25,266.73	$ 30,320.07	$ 31,836.08	$ 33,427.88	$ 35,099.28	$ 36,854.24	$ 38,696.95	$ 40,631.80	$ 42,663.39	$ 44,796.56	$ 47,036.39	$ 49,388.21	$ 51,857.62	
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Revenue fron
Total Revenue	**$ 314.67**	**$ 4,213.63**	**$ 25,266.73**	**$ 30,320.07**	**$ 31,836.08**	**$ 33,427.88**	**$ 35,099.28**	**$ 36,854.24**	**$ 38,696.95**	**$ 40,631.80**	**$ 42,663.39**	**$ 44,796.56**	**$ 47,036.39**	**$ 49,388.21**	**$ 51,857.62**	
Cost of Production																
Harvesting & Planting	(123)	(1,410)	(4,181)	(5,017)	(5,268)	(5,532)	(5,808)	(6,099)	(6,404)	(6,724)	(7,060)	(7,413)	(7,784)	(8,173)	(8,582)	$12.74
Cost of Plants	(27,225)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Includes Dryi
Processing	(109)	(1,250)	(3,709)	(4,450)	(4,673)	(4,883)	(5,078)	(5,256)	(5,414)	(5,549)	(5,660)	(5,745)	(5,803)	(5,832)	(5,832)	
Transportation	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	(13,851)	Constant
Gross Profit	(40,994)	(12,297)	3,526	7,001	8,044	9,162	10,361	11,648	13,028	14,508	16,092	17,787	19,599	21,533	23,593	
Operating, SG&A Expenses																
Depreciation (Harvest & Planting Equipment)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	Straight line
Depreciation (Processing Equipment)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Straight line
Depreciation (Transportation Equipment)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Straight line
Amortization (Land)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	See amortiza
Operating Income	**$ (40,994)**	**$ (12,297)**	**$ 3,526**	**$ 7,001**	**$ 8,044**	**$ 9,162**	**$ 10,361**	**$ 11,648**	**$ 13,028**	**$ 14,508**	**$ 16,092**	**$ 17,787**	**$ 19,599**	**$ 21,533**	**$ 23,593**	
Interest Expense (Land)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Pre-Tax Income	**$ (40,994)**	**$ (12,297)**	**$ 3,526**	**$ 7,001**	**$ 8,044**	**$ 9,162**	**$ 10,361**	**$ 11,648**	**$ 13,028**	**$ 14,508**	**$ 16,092**	**$ 17,787**	**$ 19,599**	**$ 21,533**	**$ 23,593**	
Income Taxes	-	-	1,058	2,100	2,413	2,749	3,108	3,494	3,908	4,352	4,828	5,336	5,880	6,460	7,078	
Net Income	**$ (40,994)**	**$ (12,297)**	**$ 4,584**	**$ 9,102**	**$ 10,457**	**$ 11,911**	**$ 13,470**	**$ 15,143**	**$ 16,937**	**$ 18,860**	**$ 20,920**	**$ 23,123**	**$ 25,479**	**$ 27,992**	**$ 30,671**	
Revenue Growth Rate		1,239.1%	499.6%	20.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	Constant
Harvesting & Planting Cost Growth Rate		1,045.1%	196.6%	20.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	Decrease by
Processing Cost Growth Rate		1,045.1%	196.6%	20.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	Decrease by

Illustrative Maryland Commercial Miscanthus Production Cash Flow Statement (Agriculturally Marginal Land)

	Actual			Estimated	Projected											
Fiscal	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Projection I**
Net Income	$ (40,994)	$ (12,297)	$ 4,584	$ 9,102	$ 10,457	$ 11,911	$ 13,470	$ 15,143	$ 16,937	$ 18,860	$ 20,920	$ 23,123	$ 25,479	$ 27,992	$ 30,671	
Cash Flow From Operating Activities																
Depreciation (Harvest & Planting Equipment)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Depreciation (Processing Equipment)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Depreciation (Transportation Equipment)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Amortization (Land)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Change in Working Capital	(27,225.00)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Operating Activities	**$ (27,225.00)**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Cash Flow From Investing Activities																
Harvesting & Planting Equipment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
Processing Equipment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Land Acquisition	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Transportation Equipment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cash Flow From Investing Activities	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Cash Flow from Financing Activities																
Mortgage Loan	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
Cash Flow From Investing Activities	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
Net Change in Cash	**$ (68,219)**	**$ (12,297)**	**$ 4,584**	**$ 9,102**	**$ 10,457**	**$ 11,911**	**$ 13,470**	**$ 15,143**	**$ 16,937**	**$ 18,860**	**$ 20,920**	**$ 23,123**	**$ 25,479**	**$ 27,992**	**$ 30,671**	

Worst Case Expenses Amortization Table Summary

Viable Land Loan Assumptions	
Loan Amount:	$ 896,000
Interest Rate:	5.2%
Term:	30
Amortization:	30
Interest Only:	0
LTV	80
Total Annual Loan Payment	$ 59,040

Annual Summary

Year	Interest	Principal	End Balance
1	$ 46,291	$ 12,749	$ 883,251
2	45,612	13,428	869,822
3	44,897	14,144	855,679
4	44,144	14,897	840,782
5	43,350	15,690	825,092
6	42,515	16,526	808,566
7	41,634	17,406	791,160
8	40,707	18,333	772,827
9	39,731	19,309	753,518
10	38,703	20,338	733,180
11	37,620	21,421	711,759
12	36,479	22,562	689,198
13	35,277	23,763	665,434
14	34,012	25,029	640,406
15	32,679	26,362	614,044
16	31,275	27,766	586,278
17	29,796	29,244	557,034
18	28,239	30,802	526,232
19	26,598	32,442	493,790
20	24,870	34,170	459,620
21	23,050	35,990	423,630
22	22,895	36,146	385,723
23	22,738	36,302	345,798
24	22,581	36,460	303,746
25	22,423	36,618	259,454
26	22,264	36,776	212,804
27	22,105	36,936	163,670
28	21,945	37,096	111,918
29	21,784	37,257	57,411
30	21,622	37,418	-

Marginal Land Loan Assumptions	
Loan Amount:	$ 225,536
Interest Rate:	5.2%
Term:	30
Amortization:	30
Interest Only:	0
LTV	80
Total Annual Loan Payment	$ 14,861

Annual Summary

Year	Interest	Principal	End Balance
1	$ 11,652	$ 3,209	$ 222,327
2	11,481	3,380	218,947
3	11,301	3,560	215,387
4	11,112	3,750	211,637
5	10,912	3,949	207,687
6	10,702	4,160	203,528
7	10,480	4,381	199,146
8	10,247	4,615	194,532
9	10,001	4,860	189,671
10	9,742	5,119	184,552
11	9,469	5,392	179,160
12	9,182	5,679	173,481
13	8,880	5,982	167,499
14	8,561	6,300	161,199
15	8,226	6,636	154,564
16	7,872	6,989	147,575
17	7,500	7,361	140,213
18	7,108	7,753	132,460
19	6,695	8,166	124,294
20	6,260	8,601	115,693
21	5,802	9,059	106,634
22	5,763	9,098	97,092
23	5,723	9,138	87,042
24	5,684	9,177	76,457
25	5,644	9,217	65,308
26	5,604	9,257	53,566
27	5,564	9,297	41,198
28	5,524	9,338	28,171
29	5,483	9,378	14,451
30	5,443	9,419	-

Base Case Expenses Amortization Table Summary

Viable Land Loan Assumptions	
Loan Amount:	$ 448,000
Interest Rate:	5.2%
Term:	30
Amortization:	30
Interest Only:	0
LTV	80
Total Annual Loan Payment	$ 29,520

Marginal Land Loan Assumptions	
Loan Amount:	$ 112,768
Interest Rate:	5.2%
Term:	30
Amortization:	30
Interest Only:	0
LTV	80
Total Annual Loan Payment	$ 7,431

Annual Summary (Viable Land)

Year	Interest	Principal	End Balance
1	$ 23,145	$ 6,375	$ 441,625
2	22,806	6,714	434,911
3	22,448	7,072	427,839
4	22,072	7,448	420,391
5	21,675	7,845	412,546
6	21,257	8,263	404,283
7	20,817	8,703	395,580
8	20,354	9,166	386,413
9	19,866	9,655	376,759
10	19,351	10,169	366,590
11	18,810	10,710	355,880
12	18,239	11,281	344,599
13	17,639	11,882	332,717
14	17,006	12,514	320,203
15	16,339	13,181	307,022
16	15,637	13,883	293,139
17	14,898	14,622	278,517
18	14,119	15,401	263,116
19	13,299	16,221	246,895
20	12,435	17,085	229,810
21	11,525	17,995	211,815
22	11,447	18,073	192,861
23	11,369	18,151	172,899
24	11,290	18,230	151,873
25	11,211	18,309	129,727
26	11,132	18,388	106,402
27	11,052	18,468	81,835
28	10,972	18,548	55,959
29	10,892	18,628	28,705
30	10,811	18,709	-

Annual Summary (Marginal Land)

Year	Interest	Principal	End Balance
1	$ 5,826	$ 1,605	$ 111,163
2	5,741	1,690	109,473
3	5,651	1,780	107,693
4	5,556	1,875	105,818
5	5,456	1,975	103,844
6	5,351	2,080	101,764
7	5,240	2,191	99,573
8	5,123	2,307	97,266
9	5,000	2,430	94,836
10	4,871	2,560	92,276
11	4,735	2,696	89,580
12	4,591	2,840	86,740
13	4,440	2,991	83,750
14	4,281	3,150	80,600
15	4,113	3,318	77,282
16	3,936	3,495	73,787
17	3,750	3,681	70,107
18	3,554	3,877	66,230
19	3,348	4,083	62,147
20	3,130	4,301	57,846
21	2,901	4,530	53,317
22	2,881	4,549	48,546
23	2,862	4,569	43,521
24	2,842	4,589	38,229
25	2,822	4,609	32,654
26	2,802	4,629	26,783
27	2,782	4,649	20,599
28	2,762	4,669	14,086
29	2,742	4,689	7,226
30	2,721	4,709	-

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