

**Acutec Precision Aerospace Implementation of Sustainability Practices to Reduce
Energy Consumption**



**ALLEGHENY
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Abstract

Acutec Precision Aerospace is a small aerospace manufacturing company located in Meadville, PA. Throughout this project, I worked with Acutec to determine ways to reduce their energy consumption within their Meadville facility. Doing this led to cost savings as well as creating a competitive advantage with the marketing of being a green company. I researched how the usage of renewable energy from the implementation of solar panels, changes to the lighting system, and a more energy-efficient central heating and cooling system can reduce energy consumption within Acutec. Using tools such as PVWatts I determined where solar panels could potentially be installed as well as estimates of the energy production the systems would generate. From conducting my research I found ways that Acutec Precision Aerospace can reduce its energy consumption which will not only benefit the environment but also lead to increased profits and stronger customer relationships. This is an important change for Acutec as new regulations within Europe which is where their biggest customers are located businesses are now required to publicly release their carbon emissions and energy consumption for the year. In this project, I conducted a cost-benefit analysis of the different suggestions made to determine what future cost/savings there would be after implementing the new policies.

Chapter I: Introduction

Sustainability within a business is important not only for the protection of the environment and its natural resources but also contributes to the success of the business. Corporate sustainability has been becoming more popular over the years as a successful business strategy that also protects the environment. The future of business involves corporate sustainability as we begin to see more regulations that are required for businesses to follow. Corporate sustainability is being used to ensure the future has the resources and natural environment to survive as we implement new technologies and strategies to better protect the environment. Yale Library defines corporate sustainability as “a business approach that creates long-term shareholder value by embracing opportunities and managing risks deriving from economic, environmental, and social developments” (Yale Library, n.d.). Corporate sustainability is used to change business practices to ensure that they are reducing long-term detrimental effects on the environment. One of the main examples of this challenge that these businesses are facing is carbon emissions and the release of greenhouse gasses. Only around 60% of businesses have sustainability strategies such as renewable energy or reduction of their energy consumption implemented within their corporation (Rafi, 2022).

Some businesses that have already begun to implement these sustainable business practices are companies such as Walmart and Patagonia. Walmart saw how sustainable practices can have huge savings by installing LED bulbs in their stores which produce less heat, contain no mercury, and use significantly less energy than other types of lights (Des Moines Register, 2015). These are key steps to reduce energy consumption and lower the company's total carbon emissions with a step as simple as changing their light bulbs. Walmart invested \$17 million to

develop an LED lighting system in their store's refrigerators. This cut energy consumption by three quarters and they save about \$3.8 million a year. This investment of \$17 million was paid off after only 5 years, and since then there have been pure savings because of this change (Des Moines Register, 2015). Patagonia is a clothing and apparel manufacturing company that has fully invested in having corporate sustainability practices used in its business strategy. Patagonia has policies such as “Patagonia Worn Wear” which allows items to be repaired cheaply or sold back to the company for Patagonia to sell. From using these policies Patagonia has become one of the most sustainable companies as they can reduce the amount of resources needed to produce their products as well as they are extending the life of existing products by repairing them rather than discarding them (Michel et al., 2019).

These businesses' main approaches to corporate sustainability are to measure energy consumption, reduce emissions, and create efficient supply chain management (IBM, n.d.). Businesses that have sustainable business practices want to manage their energy usage and make it as efficient as possible. Many businesses have replaced their lighting and appliances as well as implemented renewable energy into the business. Some major sustainability goals of these businesses are centered around their greenhouse gas emissions and trying to become carbon neutral. This can happen by the design and construction of the companies' buildings being environmentally friendly or even as simple as reducing electricity use. Having an efficient supply chain is important as it can make your business more sustainable, it can reduce your carbon footprint if you can source your materials locally and reduce your business's greenhouse gas emissions.

Corporate sustainability is not implemented in every business, as many claim it is too expensive and they don't have the additional funding for these projects and policies. There are

many factors as to why these types of policies aren't available for all businesses such as cost or inadequate staffing. For example, it takes time to fully invest a company in sustainable business practices (Maryville University, 2021). Every business is focused on increasing profits and most of the time they don't want to allocate the funding that they have available to spend on making sustainability a priority within their business. Some of the costs that are associated with sustainability are investments in a company's building, equipment, and investments into staff. There are many designs and building a green building is roughly 10% to 30% on top of the cost of the building (Razin, 2016). This can be a huge investment for businesses that don't have access to those large operating cash flows to invest in sustainable practices. However, environmentally friendly buildings can cost less to operate and maintain than traditional buildings which is why some corporations spend extra on the building (Dwaikat & Ali, 2016). Hiring is expensive and time-consuming, and most businesses don't already have staff members to create sustainable business policies. For example, it costs around \$4,000 and 24 days for a company to hire a new employee (Vasconcellos, 2023). The cost doesn't just include adding a salary to the business; there are other costs like recruiting costs, training costs, and even the cost of workplace integration (Mueller, 2023). The company needs to hire someone to do a business assessment of the company to determine what it needs to improve on to hit its sustainability goals. These types of projects are a huge commitment and require time and effort, it is hard for smaller businesses to focus on sustainability (Barbosa et al., 2020).

There are huge environmental and social consequences associated with the lack of corporate sustainability within the business world. With the increase of global warming and the destruction of many ecosystems we are living beyond the world's means (Straton, 2006).

If nothing is done to fix these issues we will make our planet uninhabitable as we will use up all of the clean resources and pollute our living spaces. There are many ways that sustainable business practices can benefit and protect the environment. If corporations were to reduce their greenhouse gas emissions by 5% each year, emissions would be 50% lower in 2050 than in 2010 if the global economy continues to grow at a rate of 3.5% per year (Randers, 2012). Not only does the lack of corporate sustainability negatively impact the environment but it may also affect a company's profits. One of the many benefits of sustainable practices within a business is the savings associated with these policies. In 2000, DuPont pledged to reduce their carbon emissions by 65% lower than their 1990 levels. In 2007 they achieved this goal and reduced their emissions by 80% below the 1990 levels. This created financial savings for the company of about \$3 billion between 2000 and 2005 (Des Moines Register, 2015). Another benefit to sustainable practices within businesses is customer loyalty. As a corporation, it is important to have loyal customers willing to purchase products that increase sales and develop strong customer relationships. It has been found that consumers are more likely to purchase products from corporations that practice corporate sustainability (St. Louis & Cazier, 2010). An example of this is Patagonia has a very high customer retention rate because of its sustainable policy where customers can repair their products for a small fee or trade-in used products for credit to be used on their website or in-store (Michel et al., 2019). This means that a company is losing potential customers and sales to other companies because they don't practice corporate sustainability.

An energy audit is used as a tool to calculate and analyze the conservation of energy within a building. Some of the components of an energy audit are locating air leaks, checking ventilation, insulation levels, heating and cooling equipment, lighting, appliances and

electronics, and overall building plan (Energy.GOV, n.d.). Using energy audits is a great tool when trying to reduce the consumption of energy within a business. They can be used to identify problem areas and where to focus your attention and funding when becoming sustainable. Energy audits can calculate your total savings that come from the recursion of energy consumption to determine if the changes you want to make have benefits that outweigh the cost of doing it. This will be a big part of this project as this will tell us what we need to focus on and what we can do to reduce our energy consumption.

Acutec Precision Aerospace is a company founded in 1988 that specializes in aerospace and power generation manufacturing located in Meadville, PA. Acutec manufactures aerospace parts for rotor and vibration damping, engine and power generation, hydraulics and actuation systems, landing gear and braking systems, and rod end centers (Acutec Precision Aerospace, n.d.). Acutec was excited to participate in this project as they have to implement new sustainability as mandated by some of the companies that they supply products to. The EU Corporate Sustainability Reporting Directive (CSRD) is a new policy that requires large businesses operating in the EU to disclose their information on sustainability performance annually (Yamamoto, 2023). Acutec works with companies such as Airbus which is located in the EU so they need to start disclosing their emissions as well. In participating in this project Acutec will learn more about how they as a business can reduce their energy consumption as a start to reducing their annual carbon footprint.

The goal of this research project was to determine how corporate sustainability practices can be implemented by Acutec Precision Aerospace to reduce their energy consumption. Working with the company I was able to get an understanding of what they are currently doing for sustainable business practices as well as talk about what they want the future to look like for

Acutec Precision Aerospace. Using the information that I got in the interviews I want to identify specific areas of concern to determine what we can change about the business. By using the research I have found about corporate sustainability I will hopefully be able to find strategies and different products that Acutec Precision Aerospace can use to improve their sustainability practices such as how to reduce their energy consumption.

Chapter II: Literature Review

2.1 Introduction

To get a real understanding of the effects that corporate sustainability has on a business this paper will examine the literature about how sustainability can create a competitive advantage, increase customer retention, and save on annual costs of the business. With corporate sustainability growing rapidly within the business sector it is important to look at how this will not only benefit the environment but it will also positively contribute to the business. My introduction to this project talked about why corporate sustainability is important to implement into a business and the positive effects that it can have on the environment. The literature review in this paper will tie together different research done on corporate sustainability and show the effects it can have on improving a business in many different aspects.

2.2 Competitive Advantage

This project shows how corporate sustainability can create a competitive advantage for a business. The definition of competitive advantage is: “anything that gives a company an edge over its competitors, helping it attract more customers and grow its market share” (BDC, n.d.). Competitive advantage is important for the success of a company if its goals are to have the

majority of the market in an industry. This section discusses how corporate sustainability can create a competitive advantage within a market for a business as well as the positive impacts that it has on a business.

It is important to understand what a competitive advantage is and how this helps the business. In 1980 Michael Porter identified two different types of competitive advantage, low cost and differentiation competitive advantage. According to Porter, a firm can use labor and capital to obtain a competitive advantage by selling their products at the lowest cost in the industry. Firms can also use differentiation strategies such as corporate sustainability to create unique processes or features for their products to achieve a competitive advantage (Orsato, 2006). Businesses that are beginning to implement corporate sustainability strategies would achieve a differentiation competitive advantage as they will begin to run their businesses with new innovative renewable technologies or processes to become more sustainable.

Through my research, I have found that companies can establish a competitive advantage in their markets with corporate sustainability because it improves the image and reputation of a given firm. Adopting sustainable business practices has a positive impact on the identity of a company as well as branding, which has a direct impact on competitiveness as it forces sustainable development on corporate strategy (Vilanova et al., 2008). Using sustainable strategies companies can market and advertise their products as made sustainably to attract new customers to their products. You can also use sustainability to strengthen relationships with stakeholders through stakeholder management to get that competitive advantage over other businesses in the market (Vilanova et al., 2008).

When reading about this study that was conducted on Taiwanese manufacturing companies they investigated the influence of corporate environmental ethics on competitive

advantage. The study found that investing resources and efforts into corporate environmental ethics or sustainable practices will enhance a firm's green product innovation leading to an increase in competitive advantage in the Taiwanese manufacturing industry (Chang, 2011).

The deterioration of our natural resources and environment has been decreasing our quality of life which has been forcing people to reevaluate their priorities and lifestyle. We have begun to see an increase in pollution in our water systems and our atmosphere. Not only have we seen the increase of pollution but we have also seen how climate change is affecting our daily lives and ecosystems around the planet. With the rise of boycotts through social media and the news we have seen more of the population turn to companies who support sustainability as an effort to try and compensate for their contributions to global warming and climate change.

When talking about creating competitive advantage through the implementation of sustainable business practices it is important to look into sustainability regulations throughout the world. There are some companies located in the EU that have had to change their suppliers and strategy due to the EU Corporate Sustainability Reporting Directive (CSRD). This is a new policy that was implemented in Europe to make businesses embrace sustainability within their business. They are now required to disclose their sustainability performance information annually such as their carbon emissions (Yamamoto, 2023). These companies now even have to report their supply chain sustainability, this opens up the fact that if you currently don't have sustainability policies in place this could cause you to lose business with a major manufacturer. If your business has sustainable business practices in place and you can disclose your carbon emissions annually and show how you are protecting the environment this gives you a competitive advantage over all other suppliers. You will be able to attain the business of these manufacturers that need to disclose their carbon emissions annually.

2.3 Customer Retention

Through corporate sustainability, businesses can see an increase in customer retention and new customers. Companies that are implementing sustainability into their business plan are beginning to create brand loyalty as well as creating policies that help to retain their customers. Customer retention and loyalty are when customers choose to continue to buy products from certain companies because of how they are treated or because of how the business is run. With the long-term effects that businesses are causing on the environment a higher percentage of the population is beginning to support businesses that try to protect and clean the environment.

One example of a company that has amazing customer retention and relationships is Patagonia. They have been known as one of the most sustainable companies with their sustainable business policies (Michel et al., 2019). One way that Patagonia has managed to increase its customer retention through sustainable practices is by creating long-lasting products (Michel et al., 2019). Patagonia creates its products with high-quality materials to ensure that their products have a long life span. Customers rely on Patagonia and trust that the products that they purchase from them will last a lifetime. Although no products last forever Patagonia offers a service where they will repair your damaged products for a low cost and return them to you looking as good as new. This is an amazing policy that they have not only because it supports sustainability but also because it creates trust in the brand (Michel et al., 2019). This policy is a great sustainability change as they are encouraging the use of their service to repair the product rather than throw it out and purchase something new. This allows fewer products to be manufactured leading to fewer natural resources being used and carbon emissions not increasing. If you want to get rid of your Patagonia product rather than have it repaired you can trade it in.

This is selling your product back to Patagonia so that they can recycle the materials and make new products with it. Patagonia offers store credit for your used products to purchase a different product from their website or in-store. This is also an amazing way that being sustainable increases customer retention as it entices the consumer to continue to purchase from Patagonia as they can always get their money's worth with their products purchased (Michel et al., 2019). In the conclusion of this paper that investigated customer attachment to Patagonia as a brand, they found that Patagonia has a high customer retention. Their findings found that customers' motivations to prolong the use of Patagonia products and their emotional attachment to the brand bring financial benefit to Patagonia with the increase in customer retention (Michel et al., 2019).

2.4 Savings

Implementing new policies and technologies in a business to reduce energy consumption not only protects the environment but can lead to huge annual savings within the business. Businesses can save money as well as resources if they are to implement sustainable business practices in their manufacturing business.

When implementing sustainable business practices into a business strategy it can lead to many cost reductions within the business. Some of these costs are due to reduced energy consumption or use of renewable energy during the production process, reduced material storage and handling costs, reduced waste disposal, material substitutions, or less packaging used (Epstein & Roy, 2001). The sustainable business practices used to create these savings not only generate a cost reduction through efficiency but can also have a positive reaction from consumers leading to higher customer retention as well as a competitive advantage. You can create this competitive advantage by selling your product cheapest on the market due to the savings in production which can attract more customers and generate more sales.

An example of a business that was able to create annual savings through the implementation of sustainability practices is an Egyptian Hospital that has projected annual energy savings of 41% through sustainability changes. This hospital was able to reduce its annual electricity use by 6.88kWh/m² per year. This equated to a saving of €1.25/m² per year by making improvements in their heating and cooling systems, lighting, and building maintenance. With the conversion of m² to square footage it is about 1 square meter to 10 square feet, Acutec has a building of 210,000 square feet so their annual savings with some simple adjustments could be around \$28,350 annually in savings from reduced energy consumption. Although this doesn't seem like a crazy huge savings it is important to look at the fact that this would be annual savings and over time would pay off the costs that were endured to make these changes.

There have also been changes made by Walmart where they have invested \$17 million into developing a new LED lighting system that was implemented into their stores' refrigerators globally. By doing this Walmart was able to cut their energy consumption of the refrigerating systems by three quarters leading to an annual savings of about \$3.8 million (Des Moines Register, 2015). Walmart was able to pay off its initial investment of \$17 million after only five years with the annual savings from the investment.

With the savings that are generated from the changes made, they can reinvest in their business to improve product quality, efficiency, and performance.

2.5 Conclusion

From analyzing substantial research on how corporate sustainability can positively impact a business it is clear that there are smart changes that will lead to increased revenue and savings every year for these businesses. With corporate sustainability being implemented into a

business you will create a competitive advantage within the market, see increased customers as well as increased customer retention and you will see savings associated with the cost of running the business. Not only will corporate sustainability protect the environment for future generations, but you can see how many businesses will be positively impacted by the changes they can make to become more sustainable.

Chapter III: Methods

Throughout this project, I worked with Acutec Precision Aerospace to conduct research and determine ways to reduce their energy consumption and make the business more sustainable. Through my process, I looked at data provided by Acutec Precision Aerospace, conducted a literary review about corporate sustainability, as well as found solutions for the business to implement to reduce their yearly energy consumption. The goal of this project is to be able to reduce Acutec Precision Aerospace's energy consumption and make the business more sustainable, which will create a competitive advantage for the company, increase customer retention, as well as save the business money.

3.1 Data

Acutec Precision Aerospace already has data for the facility for its energy consumption. The data that Acutec Precision Aerospace provided was monthly energy consumption for the plant, as well as information about their lighting, heating system, and factory roof. The energy consumption data provided was analyzed to see their total consumption in kilowatt-hours (kWh). Acutec also provided me with the amount they spend every month on their electricity bills. Utilizing these totals, I can identify areas that can be more efficient, and research to see how to reduce energy consumption. I will also be able to compare these consumption numbers to public

competitors to see how Acutec Precision Aerospace competes with other businesses. Using public companies I will be able to find the public records online to compare the energy consumption between Acutec and other companies. This data provided by Acutec Precision Aerospace will give me the necessary information to see what needs to change to reduce their energy consumption.

3.2 Literary Review

When gathering information for my project, it would be beneficial to research how corporate sustainability has been implemented into a business. I need to know how other businesses have implemented these policies in the past and what I need to do for the changes to be successful. It is also important to know how these changes have impacted the businesses and what they gain from implementing sustainability into the businesses. Using this research, I will conduct a cost-benefit analysis to determine if the changes to Acutec will have benefits that outweigh the costs. This will then allow me to determine how long my project would take if Acutec accepts my suggestions. A timeline is essential because we need to know how long this would take to implement as well as a rough estimate of the cost. Using this information, I will be able to also research different machines and lighting solutions that can be beneficial to reducing energy consumption for the business as well as the associated cost of these changes. I want to see how corporate sustainability has affected past businesses in both positive and negative ways.

3.3 Energy Proposal

Once all of my data was collected and analyzed I created a final sustainability proposal for the business. In this final business proposal, I outlined the project's goals, the vision for the

future of the business, a description of the market, the competition, the advantages, and a financial assessment of the changes being made. For the goals of the project, I discussed the sustainability goals that the business owners want to reach, and the future of the business. I researched the advantages other businesses have had after making the changes outlined by the owners from personal research. It was important to set these goals early as this is what the project will be working for. I will make sure that when I am researching the changes they are relevant to the size and business structure of Acutec. When completing the research it will be important to consider this as once these changes are made it will be important to let the community know of these changes. That means that we will have to create some new marketing strategies to let Meadville, PA know of the important steps and changes that Acutec is making. Finally, I will make a financial assessment that will estimate the savings and increased revenue that we should see after we implement the sustainability changes. These savings and revenue increases might be from energy and electricity savings. When creating this sustainability plan I will have to have clearly defined steps that need to be taken to achieve the goals, they need to be measurable and achievable to succeed. We need to create a timeline to achieve our vision of the business, this timeline will include all the changes and steps that are required to make the project successful.

Chapter IV: Results

Acutec Precision Aerospace provided me with the total energy usage used for their plant located in Meadville, PA. The three areas I focused on were solar implementation, the lighting system, and the heating system for the building. In Table 1 you can see their monthly energy usage for 2022 in kWh. In 2022, Acutec consumed 2,283,403 kWh of energy with an average usage of 190,283 kWh of energy usage per month. There was a high of 296,449 kWh consumed

in June and a low of 101,218 kWh consumed in December. In 2022 Acutec spent a total of \$393,497.12 on their electric bill. Using these numbers I investigated what can be done to reduce energy consumption with a focus on the implementation of a solar energy system, changes to the lighting system, as well as their central heating and cooling system.

Table 1.
2022 Monthly Energy Usage

Month	Usage (kWh)
January	233,313
February	231,079
March	248,881
April	240,711
May	264,789
June	296,449
July	143,220
August	163,150
September	142,985
October	113,857
November	103,749
December	101,218
Total	2,283,403

Table 1. Total monthly energy usage (kWh) in 2022 of Acutec Precision Aerospace manufacturing plant in Meadville, Pennsylvania.

My initial thought when I began my research was how much solar panels cost, after doing some research I found that the average in 2023 was \$0.97 per watt for a commercial system. Using this number I will give my estimation for the cost of the system. When researching more about installing solar at Acutec I found out that their roof was ineligible for solar panels to be mounted to. The roof won't be able to safely support the weight of the solar panels. Although this sounds like an issue it isn't. There are other options such as ground mounting systems that would work for Acutec in this situation. Using a tool called PVWatts I was able to use a satellite image of an Acutec Precision Aerospace building to determine areas of the plant where solar panels would be eligible to be installed. It provides an accurate estimate of how effective the solar panels would be by using software and coordinates to take weather, sunlight, and location into account. If Acutec installed solar panels on their building to make the change to green energy they would be eligible for a tax credit of 30% of the total cost of the solar system. This adds incentive and they can get some of the money back that they are spending on this expensive system. Acutec can choose to replace the roof and be able to install the solar panels on top of the factory or choose to create covered parking areas utilizing these solar panels by mounting them at ground level. There are support systems that have been created that can hold these solar panels up above the ground so that they can be used in a situation such as Acutec which can't install solar panels on their roof without the expensive cost of replacing it.

Figure 1.
Available Solar Locations

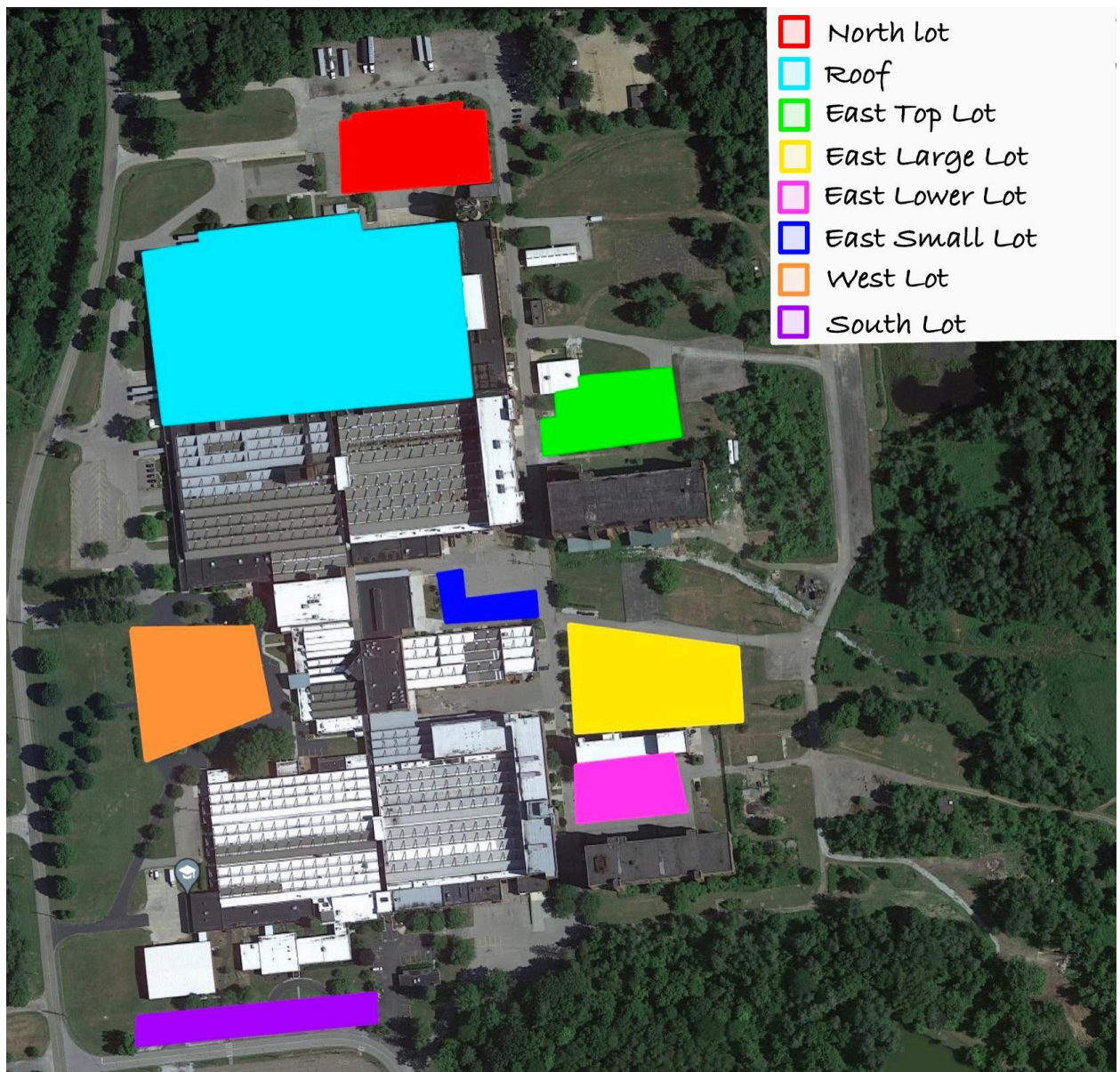


Figure 1. This map shows the available parking lot and roof locations where solar panels would be able to be installed. The colors shown are labeled in the top right corner to determine what areas I talk about in the results.

If Acutec decides to replace their roof to install the solar panels on it this would cost an estimated \$800,000 to replace the 190,000 square foot section needed to install the solar panels and would be even more expensive to replace the entire roof. Using the PVWatts tool it estimated that if the roof was replaced and solar was installed on top of the building it would generate 3,556,305 to 3,832,787 kWh of renewable energy annually. This means that Acutec Precision Aerospace would generate more renewable energy annually than the amount of energy they consume on an annual basis. To achieve these numbers Acutec Precision Aerospace would need to install at least a 3134 kw system. The cost of this system is very high considering how much power they need to generate, at the rate of \$0.97 per watt, and converting this to kw means per kw the cost would be \$970. For the 3134 kw system, we would multiply 970 by 3134 giving us an estimated total cost of \$3,039,980. The only point in time that was estimated that the solar panels wouldn't generate enough energy for the month is January. Acutec Precision Aerospace could be fully runoff of renewable energy which can have a significant impact on making the business more sustainable. Although there is a very high initial cost of implementing solar panels, these solar panels will pay themselves off over time as there will be no need to pay electricity bills anymore and you can sell back the leftover energy produced by the solar panels. This solar energy system can save Acutec Precision Aerospace thousands of dollars annually by reducing the amount they spend on electricity per month. Acutec used a total of 2,283,403 kWh of energy in the year 2022, with this roof system being able to generate 3,556,305 to 3,832,787 kWh of renewable energy annually there will be lots of leftover energy to sell back to the power company. With an excess of 1,272,902 kWh annually they can sell this to generate even more profit. In Pennsylvania, you can sell your extra energy by the kw for the going price. For the year 2022, Acutec was purchasing their electricity per month anywhere from \$0.08 to \$0.21 per kWh.

This means that if Acutec were to sell the excess power generated they could receive between \$101,832.16 and \$267,309.42 annually to contribute to paying off their solar system. With the savings from not having to pay electricity bills plus the amount of energy they can sell back, Acutec would be gaining an estimated \$495,329.28 to \$660,806.54 in savings per year for electricity. This means that for the \$3,039,980 they would be able to pay it off in 5 to 6 years. Looking at the cost versus the benefit of the solar panels we can see that Acutec would be saving way more money than they are spending on the system considering that solar panels should last 20 to 25 years.

Figure 2.
Solar Panel Energy Generation Estimates

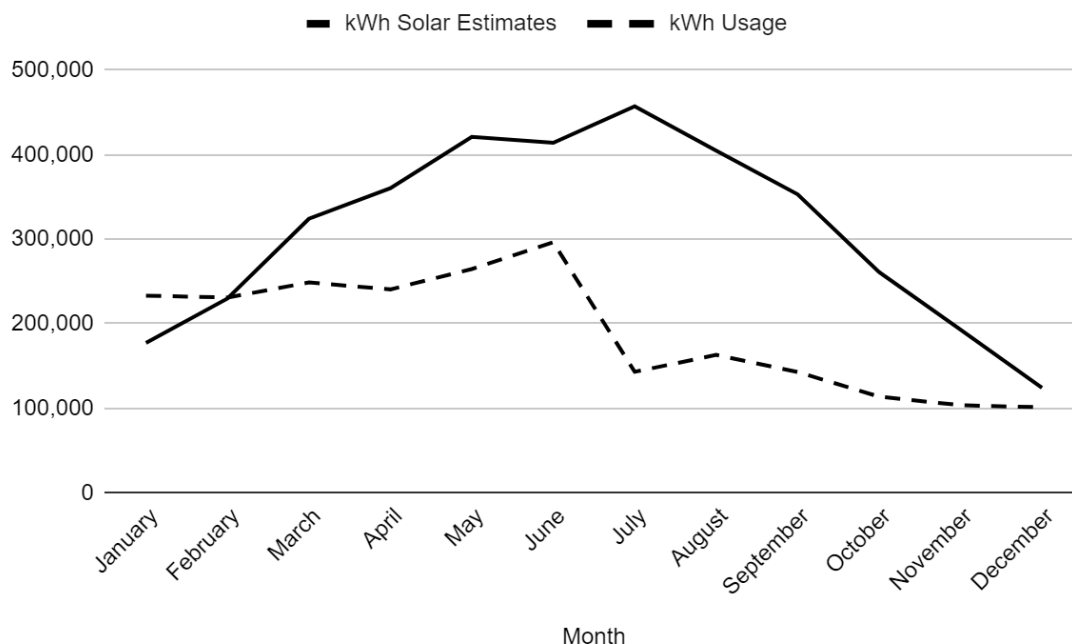


Figure 2. Estimated total energy generation for each month if solar panels were installed on the roof of Acutec Precision Aerospace located in Meadville, PA. This estimation is based on the PVWatts tool.

Another option that Acutec has with solar implementation is to install solar panels in the parking lots. This is a great idea as it removes the cost of replacing the roof and it will create covered parking for the different parking lots around the facility. One downside to this is that the size of the system would be smaller, and there would be less energy generated from these systems. Using the PVWatts tool I found different parking lots surrounding the facility that can be used to create covered parking with solar panels. There are a total of seven parking lots around the building where solar panels could be installed.

The north lot would generate an estimated amount of 811,660 kWh per year with a 692.1 kW system. This system would cost \$671,337 to install in the north parking lot. This system wouldn't be able to generate enough energy to fully run the facility on generating an average of 67,638 kWh per month. By calculating the amount of energy generated from the solar panels and multiplying it by the average cost per kWh for the year of \$0.18 we see that the system would save Acutec \$146,098.80 per year. This means that the savings generated from the use of the solar panels Acutec would pay off the cost of the solar system after 4.5 years. The east top lot would generate an estimated amount of 504,406 kWh of solar energy per year with a system size of 430.1 kW. This system would cost \$399,993 to install in the east top lot. This system also wouldn't be able to fully run the facility as it generates an average of 42,033 kWh per month. This system would save Acutec \$90,793.08 per year. This means that Acutec will be able to pay off this system after 4.4 years. The East large lot solar system would generate an estimated amount of 981,000 kWh per year with a system size of 836.5 kW, the cost of this system is \$811,405. It would generate an average of 81,750 kW per month. This system would save Acutec \$176,580 per year. This means that the east large solar system would pay itself off from

the savings after 4.6 years. The next parking lot that I looked at was the east small lot. This is a smaller system and it would generate an estimated 223,771 kWh per year with a system size of 190.8 kW. This system would cost \$185,076 to install and it would generate an average of 18,647.6 kWh per month. This system would save Acutec \$40,278.78 per year and would pay off the system within 4.6 years. The south lot would generate an estimated 491,506 kWh per year with a system size of 419.3 kW. This system would cost \$406,721 and would generate an average of 40,958.8 kWh per month. This system would save Acutec \$88,471.08 per year meaning the savings would pay off the cost of the solar system after 4.5 years. Finally, the last parking lot where solar could be installed in the west parking lot. This system would generate an estimated 825,497 kWh per year with a system size of 703.9 kW. The cost of this system is \$682,783 and it would generate an average of 68,791.4 kWh per month. The west parking lot system would save Acutec \$148,589.46 per year meaning the savings from this system would pay off the initial cost after 4.6 years. When conducting this cost-benefit analysis it is important to factor in that these changes are needed within Acutec to continue their business with major customers such as Boeing since Europe implemented the new policy where manufacturers are needed to release their carbon emissions and energy consumption. There would be a significant loss of sales and revenue generated for the year if Acutec lost these major customers.

Acutec is a large facility with 300,000 square feet of space inside the building. There needs to be a lot of lights for the facility to operate properly. Throughout the building, there are 683 total light fixtures with 3258 total bulbs. In 2022 Acutec refitted the entire building with 15-watt LED bulbs. This was a step in the right direction with the switch from fluorescent bulbs but there is still a way to save energy with lower-wattage bulbs such as a 12-watt option. The

standard is 8 bulbs per light fixture in the production area and 2 bulbs per fixture in the office and administrative spaces. On average businesses are typically open for 8 hours per day which is what the estimated time of usage is for the lights within the building. The watts per fixture on the factory floor are 120 watts using 15w bulbs and 96 watts using 12w bulbs. The watts per fixture in the office and administrative space is 30 watts using 15w bulbs and 24 watts using 12w bulbs. To find the amount of energy and money saved per year I found the amount of energy saved per bulb replaced, estimated the annual run time of the lights, and then calculated the annual savings. To find the energy saved for every bulb replaced you take the old bulb 15w and subtract the new bulb 12w to get 3w. To figure out the run time I took the average 8 hours a day a business would be open and multiplied it by 360 days accounting for holidays to get a total run time of 2880 hours per year. The 3w per bulb saved multiplied by the run time of 2880 hours and then divided by 1000 to get the kWh we see that the annual savings would be 8.64 kWh per bulb leading to an annual total savings of 28149.12 kWh per year in energy savings. The total saved per bulb is calculated by taking the savings per bulb at 8.64 and multiplying it by the cost per kWh which is \$0.18 and we get savings of \$1.56 per bulb and a total saving of \$5,082.48 per year.

Acutec uses an electric forced air heating and cooling system as the building's main temperature-controlling source. For my suggestion about the changes made to the central heating and cooling systems, I recommend that they keep what they currently have. Electric central heat and cooling systems are a good option as they don't burn natural gas to work. They use electricity to warm or cool the air before it is pushed through the vents. There are more energy-efficient and newer options for electric heating and cooling systems that Acutec could buy to replace their current model but the small amounts of energy savings don't outweigh the

huge cost to replace the current system that they have installed. It would cost Acutec hundreds of thousands of dollars to replace its system with the newest and most efficient with a very minimal decrease in energy consumption. In the future, Acutec can replace this system with a new electric system once it breaks and they need to make a change but for now, I recommend that they keep what they currently have.

Acutec Precision Aerospace now has the options and ability to implement these policies into their business strategy to benefit their company and protect the environment. Using these changes Acutec can reduce their yearly energy consumption as well as save money over time from the changes being made. These changes will allow Acutec to report their sustainability efforts to satisfy the companies in Europe that they currently supply aerospace parts for.

Chapter V: Discussion

Throughout this project, some key findings in my research impacted my study substantially. First of all, the use of solar to power a business can greatly reduce the yearly cost of electrical bills and can reduce the business's carbon footprint by using green energy but it comes at a very high initial cost that is hard to produce at the time of installation. The reason that we see many businesses not convert to solar energy is the pure cost of the panels and installation depending on the size of the system needed. This is a high cost but it can lead to the business overproducing solar energy which can be sold back to power companies for a profit monthly to pay for the system over time. This is where it is important to conduct a cost-benefit analysis to ensure the investment is worth it for your business. The easiest and most cost-efficient way to reduce energy consumption with a business is to make sure the business switches from

fluorescent bulbs to LED bulbs. This can save thousands a year on electricity costs as well as make improvements towards becoming a green business.

Some limitations I ran into with this project are funding, research, and my actual ability to implement these changes. Throughout this project, I realized how expensive it truly is to implement sustainability into a business. These new technologies are very expensive to install and maintain which is hard for business owners to afford. Acutec doesn't have the funding available in cash to be able to make these changes instantly which is one of the problems this project ran into. This project has helped to see what can be done in the future such as replacing bulbs with lower-wattage LED ones as they need replacing and even considering changing the roof material to be able to support solar panels for the future when they need to be replaced. I also found it hard to determine an estimate for the exact cost of installing solar systems as all of the companies need to come to the business to conduct a consultation to determine what is needed for the solar system installation. Many companies advertise they can come to give a quote but it was hard to find a website or tool that was available to give an estimate online. I think it would be important to look at multiple years of energy consumption data for Acutec to determine what is the average amount used per year. Since I only used one year of data I was unable to determine if this was a year that they consumed more energy than normal, less energy than normal, or if this was around the average they consume per year. Finally, the major issue that has come from this project is that I am not the business owner of Acutec, I am not able to implement these changes. Ultimately this project was designed for me to give my suggestion for what could be done and lay out some of the estimated savings and costs for the business but I am

not affiliated with the company. I can only go as far as making my suggestions and educating the business about what changes are available

I would be interested in how future research would change what I found in this study. With the development of new technology, I believe that it will become easier to implement different sustainable business policies into the business. What would the sustainability changes be for a business that has unlimited amounts of funding available to purchase and renovate its building? Would we be able to see major decreases in energy consumption and reduction of greenhouse gas emissions with a total renovation of sustainability in a business? These are questions that I would be interested in finding answers to in the future. This topic has lots of research that can be done in the future with new technologies being released to the public at high rates.

My ultimate takeaway from this research is that corporate sustainability and the use of sustainability policies within a business are very important. Businesses have huge impacts on the environment from high energy usage to high amounts of pollutants released into the atmosphere annually. I believe that sustainability within a business is the future and we will begin to see more regulations implemented such as what Europe is doing.

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