

Brick + Mortar Art Gallery and Design Studio Energy Assessment

Scott Silver, Christian Lee, Daniel Marino

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Introduction

The Simon Silk Mill located in Easton, PA was first built in 1883 as a major economic development initiative. The mill manufactured textiles until the late 1960s and then was purchased by the Easton Redevelopment Authority (ERA) in 2006. A year later, the ERA justified that this mill can be revitalized to “host a successful arts-based real estate development project” (Lippincott). The redeveloped mill consists of 18 buildings, which is rented out by residents and business owners. This cultural redevelopment project followed through on its intentions of creating a “creative complex for individual artists and professionals... ‘Silk’ will become a tour de force in the creative community as a live work location” (VM Development). One of the businesses within the 350,000 square foot facility is the Brick + Mortar Art Gallery. Owned by an artist named Chaz Hampton, the art facility, which consists of both a gallery and a studio, encompasses everything an artist could want. From the location to the lighting, it seems that the revitalized silk mill is proving itself to provide the practical use of an art studio and the creative outlet Mr. Hampton had desired. Unfortunately, the benefits of using the abandoned silk mill are contrasted by several social, political, and technical restrictions, which collectively results in high energy costs.

It has become of interest to find the best, most efficient balance between energy efficiency and the satisfaction of Easton, the Silk Mill’s management, and Mr. Hampton. The two do not have a direct relationship. Since “The Pennsylvania Historical and Museum Commission has determined that the buildings at Silk are eligible for listing on the National Register of Historic Places,” there are numerous factors that need to remain (Lippincott). For example, there are specific features such as windows that are meant to be kept homogeneous throughout the entire mill site to keep the aesthetic nature of the historic landmark. To find the

balance we are looking for, we have performed a thorough investigation of Easton, the Silk Mill, and Brick + Mortar to identify solutions to their energy inefficiencies.

The scope of our project has narrowed as the semester went on. Our initial goal was to complete an economic analysis of alternative solutions to cut energy costs for Brick + Mortar. A truly detailed, useful economic analysis requires accurate technical information that can sometimes only be found with expensive equipment and time consuming procedures. Measuring details like airflow is not an easy undertaking, especially during the semester-long timeframe that we have, and requires measurement tools that can be costly. Our adjusted, more feasible approach is to report the necessary information to do an economic analysis, rather than performing the analysis ourselves. This way, another group of consultants can take our work and perform their own calculations to carry out the analysis. Although the eventual consideration of our project will be Mr. Hampton, our more immediate audience is another capstone group. Given our timeframe, absent budget, and lack of technical information, we believe that this is the most effective approach to our capstone project.

We have also identified the barriers that come with performing an economic analysis and any alternative implementations, which outlines our report. Looking at our project through the various contextual lenses of social, political, technical, and economic, we have identified the problems involved with each, as well as possible solutions to these problems. In a social context, have worked most closely with Mr. Hampton to identify his wants and needs for his art studio and gallery. It's important to define them separately as they are technically two different rooms, with two different uses. It would be more difficult to implement energy efficient solutions to the gallery compared to the studio because Mr. Hampton understandably values aesthetics in the gallery more than the studio. From speaking with him, he appreciates the room's exposed

infrastructure, unique lighting, and open space. Mr. Hampton, along with the Silk Mill development group, was helpful in bringing clarity to what we can and cannot do to help Brick + Mortar's energy costs.

There are several policies and regulations in place that restrict making adjustments to Brick + Mortar's building. These restrictions have been placed by the city of Easton to maintain the site's historical landmark registration and by VM Development group to preserve the historical themed style of the entire site. The homogeneity throughout the mill serves as an attraction for visitors by representing the 135 years of history.

Technical aspects of the building like square footage, layout, materials, and number of windows are helpful in understanding potential alternatives. Unfortunately, it will be too difficult for us within a single semester and no measurement tools to measure airflow or average temperature inside. Components that we placed a heavier focus on are building materials and types of lighting. We believe we can have the biggest impact here by identifying alternative materials and products and comparing them to what's used by Brick + Mortar. Through this comparison, we have identified which materials can be better used for energy efficiency.

Through an economic lense, we have provided an overview of what is necessary to perform an economic analysis. We collected as many line item costs as we could to be used for future calculations. Beyond that, we identified the economic benefits of having an urban revitalization project that integrates industrial and art with the Simon Silk Mill in focus.

The organization of our report represents our approach to the study. By identifying, investigating, and reporting on each context of the project we have provided clarity and confidence in our ability to help reduce Brick + Mortar's energy costs. Our report is ready to be

used for another group of Engineering Studies capstone students to hopefully carry out an energy efficiency, economic analysis that can be presented to Brick + Mortar.

Social and Political Contexts

We have taken on this energy efficiency analysis of Brick + Mortar with strategic enthusiasm by treating ourselves as top-down socioeconomic engineers. This entails looking beyond the specific technicalities of Brick + Mortar to include the grander context of Easton and its relationship with the Simon Silk Mill. By gaining an understanding of Brick + Mortar's roles in the city and the mill, we will be able to perform a more effective analysis.

Easton, Pennsylvania, located on the intersection of the Delaware and Lehigh rivers, is a historical city that played a vital role in the industrial revolution starting in the 1830s. Canals were built that connected the coal, iron, and steel industries throughout the Lehigh Valley. The Lehigh Valley Railroad, first chartered in 1846, was crucial in transporting “anthracite coal from the vast coal fields of Pennsylvania” all the way to upstate New York in the Finger Lakes region, but first stopping in Easton (Lehigh Valley Railroad History). Additionally, the once flourishing railroad created easy access to and from the nearby cities of New York and Philadelphia (Easton Main Street).

Easton has now developed into a center for art, significantly motivated by the Arts Community of Easton (The Arts Community of Easton). “ACE’s mission is to encourage and promote all the arts; foster an appreciation of the arts; and enrich the quality of life by offering arts involvement, education, and community programming to the Easton area,” writes ACE’s website in their mission statement. In and around Centre Square consists of many creative gift shops, unique clothing, and art galleries. For example, Mercantile Home, a home-goods shop in

Centre Square, says “we design and produce artful personal and home accessories utilizing new, organic, and recycled materials” (Mercantile Home). Slightly further down Northampton road sits Connexions Gallery where Alice Kwiatkowski and Anthony J. Marraccini have grown Connexions “into a cultural hub offering not just fine arts and crafts, but also an array of music and poetry performances not to be missed, as well as interactive arts offerings such as workshops and classes” (Connexions Gallery). In addition to its shops, the city of Easton has also developed artistic landmarks. The Karl Stirner Arts Trail converges art and nature by thoughtfully placing artwork in a “transcendent natural setting” along the Bushkill Creek for 1.75 miles (Art and Nature Converge). This arts trail has become an integral part of Easton, as well as Lafayette College as it runs directly below College Hill.

The city of Easton is unique in that it encapsulates both history and art. The installment of the Simon Silk Mill exemplifies this by revitalizing a once prospering silk mill built in 1883. Self-defined as a creative live-work complex and cultural redevelopment project, the Simon Silk Mill houses 10 buildings consisting of apartments and small businesses, many of which are art related. The Brick + Mortar art gallery, one of the components of the silk mill is the focus of our study and epitomizes Easton’s uniting of art and industrialization.

Small businesses meet many struggles while trying to succeed. At the beginning, it’s necessary for business owners to look at all facets of their business to set themselves up for success. There are policies that surround work health, employee benefits, energy codes, and many more when considering a business. They need to consider whether there is sufficient work space or comfortable heating and cooling, for example. Implementing policies like these are costly and troublesome for artists.

With a usual lack of capital and a tough art market to impede on, the main focus for a small business is typically on expenses and limiting them as much as possible. Furthermore, artists typically see little revenue and struggle with keeping galleries open unless expenses are cut. Magnus Resch, a London School of Economic graduate and current art professor and advisor, released a survey on 8,000 art galleries' revenues in his book, *Management of Art Galleries*. Bloomberg reports "fifty-five percent of the galleries in Resch's survey stated that their revenue was less than \$200,000 per year; 30 percent of the respondents actually lost money; and the average profit margin of galleries surveyed was just 6.5 percent." With little incoming revenue, a focus needs to be on limiting expenses. Resch found that the highest source of expenses come from rent, followed by salaries, art fairs, and transport (Tarmy). Included in the rent would be energy costs, a cost that we see as an opportunity to reduce through various strategies.

Our approach to this project has been to serve as top-down socio-economic engineering consultants for Brick + Mortar. We set out to understand Brick + Mortar's social importance of exemplifying the integration of art and industrials in the silk mill urban revitalization project and how it's just one of many businesses at the site. By further educating ourselves on the importance of the silk mill itself, we were able to find what challenges, and benefits, for Brick + Mortar there are by being apart of such a grand project. We then delve deeper into these contextual aspects and investigate their impact on Brick + Mortar's energy-related costs. We begin with their relationship with stakeholders in both the Simon Silk Mill and the gallery/studio itself.

Visiting Brick + Mortar, we felt tension between the tenant and the landlord, two very important players in the Simon Silk Mill and Brick + Mortar. This causes concern for the future

of the art space because a lack of communication and support can lead to extra costs. There is a service contract that VM Development group requires each tenant to sign upon moving in, yet Mr. Hampton is only one of two business owners to sign the contract. The contract is meant to provide service for any unexpected damage or dysfunctions. Though, when a recent storm hit in early November, rain freely flowed through the ceiling of Brick + Mortar. The development group's servicers failed to help, and so Mr. Hampton personally covered the costs. What's further concerning is that these leaks are common and prove poor insulation in the ceiling. This is a typical theme throughout not only Brick + Mortar, but all of the Simon Silk Mill, a major drawback of using a revitalized historical location.

As a business owner, it would make sense to repair this lack of insulation for comfort and energy cost reduction, but frustrating policy restricts him to do so. Mr. Hampton was very excited to hear this space opened up. He sought it out as a way to get involved in a community that is meant to be an up and coming, trendy location. It makes sense from an artist's perspective both perceptively and financially. Being a piece of what feels like a campus full of artists will help drive foot traffic and positively impact their gallery's image. This was enough for them to give up their location in Centre Square, the heart of Easton. Their gallery was in the former space of Easton Dollar Savings & Trust Co., which was built in 1922, but later liquidated in 1932 amidst the Great Depression. Although a historic location, it doesn't compare to the importance of the Simon Silk Mill, which brings in a new level of acknowledgement and regulation. The Simon Silk Mill is recognized by the National Register of Historic Places, which is:

“the official list of the Nation's historic places worthy of preservation. Authorized by the National Historic Preservation Act of 1966, the National Park Service's

National Register of Historic Places is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect America's historic and archeological resources” (National Historic Preservation Act of 1966).

By being registered on this list,

“It shall be the policy of the Federal Government... [to] use measures, including financial and technical assistance, to foster conditions under which our modern society and our prehistoric and historic resources can exist in productive harmony and fulfill the social, economic, and other requirements of present and future generations” (National Historic Preservation Act of 1966).

This is an optimistic, progressive approach to historic landmarks. Though, the next condition’s focus on preservation is what puts pressure on the development group to maintain historical aesthetics and thus results in disbenefits like poor insulation in the ceilings. It states that the Federal Government “provide[s] leadership in the preservation of the prehistoric and historic resources” (Beall). Preservation is important from the government agency’s perspective, but it is a big proponent of many of the energy inefficiencies discussed in this report.

Our salient question for Mr. Hampton asks if aesthetics are more important to him and his business than energy costs. There is a clear tradeoff between the two and several barriers that make it difficult to balance. There are political barriers that place struggles between governments and the development group, but then there are social struggles between Mr. Hampton and the

development group. As a business owner, it can be frustrating to not be able to do what you want with your own business, but from our perspective we wonder what he actually does want with his business. He chose the Silk Mill location for its rustic, trendy atmosphere, and would love to maintain that, but that comes with costs, many of which are energy related. We hope to prove to Mr. Hampton that there is enough opportunity in energy savings for him to spare some of the aesthetics.

The social contexts are arguably the most important of this feasibility study as they apply not only to our project. The broader themes of urban revitalization and community development are ideas that go past the geographic barrier that is Easton. Urban revitalization has been occurring for decades, with many small business owners seeing the benefits of participating in such development projects for a myriad of reasons. In Mr. Hampton's case, he was compelled by the rustic and aged appearance of the mill. However, like Mr. Hampton, many suffer from inefficient insulation, heating systems, and lighting, primarily due to the dated infrastructure and construction of the facilities. As a small business owner of an art studio and gallery, funds are scarce, which is a main design constraint. By directly interacting with a member of the community and understanding his needs for his own business, it is imperative for us to acknowledge his desire for aesthetics and understand what motivates that desire. In the end, we need to consider Mr. Hampton's desire for aesthetics but also need to confront energy costs. Ideally, the two would be balanced to optimize aesthetics and minimize expenses.

Technical Context

We are reporting on a detailed energy assessment of Brick + Mortar and the Simon Silk Mill to perform an economic analysis on what energy-related alternatives can be implemented

for cost-savings. Our assessment developed an overview of the technical features of the building and scope out the energy related aspects. For a future economic analysis to be plausible, we need to be familiar with the windows, walls, HVAC (Heating, Ventilation, Air-Conditioning), and lightbulbs of the studio before providing alternatives. An understanding of these technical aspects allows us to fully collaborate with Mr. Hampton in providing cost efficient, energy saving alternatives while striving for the goal of aesthetics.

It's first important to look at the Simon Silk Mill pre-construction. Prior to any construction, several investigations, detailed below, were done to the site by CMX Engineering to ensure feasibility of the project. These investigations offer information that helped give us a sense of what original developments were necessary for the Silk Mill project and how our proposed changes to Brick + Mortar can reflect those changes for better or for worse if undertaken. Although interesting background information, the investigation reports also helped guide us with practicality in mind so we knew what we are doing is technically possible.

One of the engineering assessments done by CMX Engineering was a structural condition assessment. The assessment and analysis was completed with fairly successful results. The majority of the buildings "are in relatively fair to good condition," but more importantly they "appear to have adequate structural floor load carrying capacity to enable their adaptive reuse as either residential, office, [or] retail..." facilities. Though, some buildings were in "poor to extremely poor condition," which led to suggestions of immediate repairs and in some cases, demolition. The cost estimate was set at \$3,140,000. The final cost of the repairs is not disclosed in the report as this was done prior to any construction (Lippincott).

The mechanical, electrical, and plumbing (MEP) investigation found that the Simon Silk Mill had a total of 350,000 square feet worth of buildings, consisting of 22 buildings, though

only 18 are being used now. The buildings were originally “heated by a central steam heating plant and a network of piping installed in tunnels,” but has now been abandoned and is not in operation. The result of the MEP study claimed that no part of the existing systems could be salvaged and all new systems would have to be bought (Lippincott).

The geotechnical team reported that “any proposed structures can be supported utilizing a shallow foundation system, consisting of strip and/or spread footings and should be designed for a maximum bearing capacity between 2,500 to 3,000 psf.” This gives us insight into what restraints the engineers had when completing their revitalization of the mill. There was also a civil site assessment, which reported information that does not pertain to our study (Lippincott).

Brick + Mortar, specifically, has about 30,085 square feet in space between its gallery and studio (Lippincott). It’s unknown what the exact difference in size is, but the studio is visually larger than the gallery. Both rooms have high ceilings, which means more energy consumption is necessary to heat and cool the rooms. The skylights in the ceilings require additional height in the ceilings because of their tilt, adding additional open space. The gallery, in particular, is mostly open space to create an aesthetically pleasing entrance to where art lines the walls. Artists have to think extensively on how they want to set up their gallery so that their art is best presented. *Inside the White Cube* is a renowned “ideology” that gallery owners have been referring to since its first book edition in 1986. Its science-like breakdown of art galleries suggest that the best way to present art is by entrapping the gallery from the outside of the world. This is described by a spectator entering one of their recommended gallery types, “in front is an open space in which the viewer’s sense of his own presence becomes an increasingly palpable shadow” and it’s just the art that sticks out. To create this seemingly abstract, unrealistic setting, the gallery owner needs to encompass their space as a ‘white cube’ with white walls and open

space, and no outside lighting (O'Doherty). Mr. Hampton is a modern artist, though, and unsurprisingly doesn't follow a 1986 approach. Although Brick + Mortar takes important aspects like open spaces and white walls, the gallery includes natural lighting from the skylights, rustic ceilings, and stand-out HVAC systems. Since there is a considerable amount of open space, the HVAC units' efficiency becomes incredibly important.

The HVAC units' ducting actually differs from each room. It's possible that the development group suspected two different businesses with two different designs to split up the buildings. It's attainable for there to be two different designs because although the Silk site uses "a central energy plant that produces and distributes thermal energy for space heating, air conditioning, and industrial purposes from a central site for the buildings," some or all of the buildings have their own individual HVAC units, like Brick + Mortar (Lippincott). The gallery contains circular shaped ductwork while the studio boasts rectangularly shaped ductwork. Both types have advantages and disadvantages. A round duct tends to be more efficient than a rectangular duct in performing the same task because of its smaller cross-sectional area with less duct wall exposed to moving air. For example, an 18-inch diameter round duct has the same air-carrying capacity as a 26-inch wide and 11-inch high rectangular duct. The cross-sectional area of the round duct is 254.5 square inches and has a perimeter of 4.7 feet, while the rectangular duct has 286 square inches of area and a perimeter of 6.2 feet. Due to the 32% increase in metal needed for the rectangular duct, the cost should be proportionately higher. The major disadvantage of having round ducts is the height of it compared to rectangular ducts making it more difficult to fit into spaces. It is unknown why the development group chose these ducts for the room they chose them for, but it can be inferred that they needed to shape the ducts in a specific way for each room (HVAC Equipment).

Heating and cooling are most contributed by the building's HVAC system, but also by its lighting, windows, casings and ceiling and wall materials. The gallery has four framed door windows at the entrance with a large stationary window above (Photo A) and a smaller single hung window to the side (Photo B). The two bigger windows are thin and have cheap plastic casing while the door windows are slightly thicker and installed within the thickness of the doors. Various materials for window casing offers different amounts of insulation. Plastic offers poor insulation due to their lack of density while metals conduct heat too easily. Wood would be a more reasonable option. Another option is to apply an insulated window glazing. Purchasing windows with low-emissivity coatings applied to them is an option to reduce energy loss by as much as 30% to 50%, though they cost about 10% to 15% more than regular windows (Window Types).

The gallery also contains four skylight windows (Photo C). Although the skylight windows naturally light up the gallery positively, mounted lights are necessary for cloudy days, nighttime, and showings. In addition, the skylight windows are poorly secured in the ceiling with visual gaps between the edges and the ceiling. The gallery has forty-five 75w Philips incandescent light bulbs held by the same number of Juno T219 fixtures (Photo C). Incandescent lighting is known to be the least energy-efficient form of lighting on the market (Department of Energy). Better options are compact fluorescent lamps (CFLs) and light emitting diodes (LEDs) (Department of Energy). The U.S. Department of Energy reported a comparison of newer lighting versus the traditional incandescent lighting, which is no longer manufactured, based on a usage of 2 hours per day with an electricity rate of 11 cents per kilowatt-hour. Brick + Mortar's type of lighting only saves about 25% of energy costs versus the traditional incandescent lighting compared to ~75%-80% in savings from CFL and LED lighting.

In the studio, there is lighting similar to the gallery, but in shapes of tubes. The studio has six skylight windows compared to the four in the gallery, which makes sense because it's larger in size. The studio also has a large window on the street-side wall and a small square window on the parking lot-side wall. The most distinct features of the studio are the two garage doors (Photo D). They allow for a loading dock and are nearly the height of the beginning of the ceiling. Although the garage doors had to remain when Mr. Hampton moved in, he had options on their materials. For aesthetic reasons, he chose the option that is least energy-efficient. By observation, these garage doors lack insulation immensely and airflow can easily be felt when standing nearby. The building is also south-facing meaning the garage doors get direct sunlight. Direct sunlight through cheap windows can translate heat into the building very easily requiring more air conditioning.

To a lesser extent, airflow can be felt while standing near any other window or door. A limitation to our assessment is measuring the airflow and being able to come to a conclusion on why they are leaking as much outside air as they are. We do not have the materials or time to research the extent of these implications, though we can speculate that the poor-insulating materials and gaps between the wall and casings create unnecessary energy costs. A possible, perhaps temporary, solution to filling the gaps is by using a spray polyurethane foam. Sold by various retailers, one claims that the spray "expands and cures quickly to fill gaps, expansion joints, and more" (The Home Depot). A simple fix such as filling the gaps between the wall and casings is a cost effective technical solution that requires minimal maintenance and is able to better insulate the studio.

The wall and floor materials are also important features to consider. The floor throughout the building is made up of concrete. Concrete can achieve thermal stability by insulating the

“almost constant” earth temperature that it lies on. Although, Mr. Hampton had told us there was a basement under their space, which leaves us to question whether it’s the right material. They have other elements, though, like absorbing radiant heat from indoor heating units. When heating is required in the winter, “the thermal mass will help keep a dwelling warm and reduce heating energy consumption” (Concrete Slab-on-ground). Due to its controlling nature, the concrete can absorb the heat during the day and release at night when the temperature decreases. Additional glazing can help emphasize concrete’s ability to stabilize thermal comfort.

Different from the floors, many of the walls are made of brick. The obvious reason for the development group to build or reconstruct the Silk buildings out of brick is for the rustic appearance to represent its history. Brick may fit the aesthetic nature of the site, but it’s not a very good insulating material. It’s thermal resistance, or R-value ($\text{m}^2 \text{ }^\circ\text{C}/\text{W}$), is 0.27 per inch (Briga-Sa) compared to a range of 0.71 to 1.41 per inch for various types of wood (Department of Energy). A higher thermal resistance notes more effective insulating properties.

If implemented, there are several alternatives that can reduce energy costs. Though, for someone to decide between several alternatives, it’s necessary to be presented with a quantifiable difference. Performing economic analyses will define the alternatives in a way for Mr. Hampton to decide if the values can justify alterations to his building’s aesthetics.

Economic Context

We are doing an energy efficiency assessment for Brick + Mortar to identify where there may be unnecessary energy-related costs and how to reduce those costs. This assessment can be further analyzed through two economic lenses. There is the broader economic vision of the Simon Silk Mill and there is the more specific Brick + Mortar’s economic context. The Silk Mill

has strategically taken advantage of an excellent opportunity by converting the historic, abandoned silk mill into an exciting location for residents and business owners to grow their lives in. It perfectly encompasses Easton's community and their growing image for an intertwined art and historic faction. Similar to the Karl Stirner Arts Trail, the Silk Mill is located just outside Easton's Centre Square, alongside the distinguished Bushkill Creek, and amidst the pure nature of Lehigh Valley. Modernizing a location like this is bound to excite the nearby community, and hopefully those outside of it too. An initial market study reported that the mill could potentially draw 80,000 to 120,000 visitors a year, locally and from beyond a 60-minute radius (Lippincott). Not only does this draw attention to the Simon Silk Mill, but it is also bound to drive traffic towards Centre Square and benefit the many small businesses located there.

The urban revitalization project of the Simon Silk Mill can also serve as a model for future projects in and around Easton. Effectively integrating art and industrial features to successfully drive economic prosperity is a creative, appealing initiative that should be replicated or used as inspiration for future projects in the area, albeit a costly investment. The Simon Silk Mill is a massive project made possible by Easton. The project had an estimated \$23 million in costs. The city had help by being given "an interest-free \$250,000 line of credit to help fund redevelopment costs" by the Northampton County Industrial Development Authority. Additionally, Historic Rehabilitation Tax Credits were given by the National Register of Historic Places. For these tax credits to be justified, the Silk Mill needs to continue to hold its place on the National Register, one of the main proponents for keeping energy inefficient features of the mill (Lehigh Valley Economic Development Corporation). The National Park Service can provide up to a 20% tax credit for the "rehabilitation of historic, income-producing buildings that are determined... to be certified historic structures," which the Simon Silk Mill is (National Park

Service). This brings our question for VM Development group and Easton to surface: are the tax credits worth the extra energy costs? This is another tradeoff that needs to be economically analyzed. A quantifiable difference needs to be calculated and presented to the necessary decision makers. This debate also sprinkles directly down to the tenants of the mill, like Brick + Mortar. So then it becomes a question that encompasses all of the contexts we analyzed for Mr. Hampton: are the building's aesthetics worth keeping to maintain the high costs of which the landlord is impelled to charge for the sake of historical benefits?

The purpose of assessing Brick + Mortar through an economic lens is to identify potential alternatives that can result in energy-related savings. It's first important to realize why Mr. Hampton was so keen on moving into the Simon Silk Mill. As noted before, he liked, and still likes, the space. Though something else he must have had in mind is the appeal of the mill to the public. For a growing arts community, Easton has an opportunity to explore their interests at an incredibly exciting new location. The creation of foot traffic specifically geared toward art is bound to generate revenue for Brick + Mortar. Although a seemingly perfect fit to generate revenue, energy-related expenses cut into their income.

We were provided by Brick + Mortar their 2018 September through October billing statements for heating and electricity. Combined for the gallery and studio, they paid UGI, their natural gas provider, \$77.15 during the 30 day period. Last winter, from December 2017 to May 2018, they used \$2,086.42 worth of gas. Their electricity provider, Met-Ed, billed Brick + Mortar \$45.48 for their 29 day period from mid-September to mid-October. Brick + Mortar used 229 kilowatts during that time at a cost of roughly 6.34 cents per kilowatts. The last 12 months billed \$764.02 in electricity. The total energy usage is relatively low compared to average households in Pennsylvania, though. Pennsylvania homes consume, on average, 10,402 kWh of electricity

for a cost of roughly \$1,350, which is almost double what Brick + Mortar paid in the last year (Household Energy). The building's use of natural lighting is a reasonable explanation for this. Natural lighting is one of the most cost-effective investments for energy because natural lighting alone can reduce total energy use by as much as 25-30% (Gago). It's important to note, though, Brick + Mortar doesn't have nor need any appliances like a washing machine, a dryer, or a household refrigerator. On the other hand, Mr. Hampton does use power tools for his art.

Our most immediate and seemingly feasible alternative is seen in the lighting. Based on 2 hours per day usage with an electricity rate of 11 cents per kilowatt-hour, Brick + Mortar's type of lighting costs \$3.50, annually, whereas CFLs and LEDs cost \$1.20 and \$1.00, respectively, annually (Department of Energy). Something to consider for changing the light bulbs in the gallery is all forty-five fixtures would also need to be changed to accommodate the new bulbs. While each fixture costs roughly \$30, the long-term cost savings would outweigh the current costs (AcuityBrands). The payback period can be calculated through an economic analysis. An alternative that would require a more extensive payback analysis is a new HVAC system. In order to conduct a payback analysis on these solutions, we would need to know the net annual cash flows generated by the investment. As we do not have this information, we are presenting the framework in which an economic payback analysis could be used in this situation. Mr. Hampton claims that the HVAC system often gets clogged from general dust and dust from his art-making tools. Not only does it cost money to get it serviced when clogged, but the clogging creates inefficient air flow. Mr. Hampton did not distinguish whether the shape of the ductwork had an impact on the dust intake. HVAC accounts for 39% of the energy used in commercial buildings and upgrading to a higher performance HVAC can result in 10% - 40% in cost savings, which makes it essential for Mr. Hampton to consider a change in his system (Graham).

The HVAC systems, along with alternative lighting and building materials, are some of the technical features that we propose to be further analyzed by doing a cost-benefit economic analysis. This information can then be presented to Mr. Hampton and VM Development Group to help balance the tradeoff between Brick + Mortar's social needs and their energy-related costs.

Conclusion

Summary:

The Simon Silk Mill has been a transformative urban revitalization project that now offers a unique integration of artistic influenced businesses and apartments in an industrial setting. It's acknowledged as a national landmark, a feat that shouldn't be discounted, it offers serene study spaces for Lafayette students, and provides a platform for small businesses to prosper. Though the mill has productive intentions for their small business tenants, there are many unwillful barriers that result in unexpected and unwanted problems. We focused on high energy costs that are associated with urban revitalization. To emphasize certain details we used Brick + Mortar Art Gallery and Design Studio as a case study.

We approached the case study by investigating Easton, the Simon Silk Mill, and Brick + Mortar through a variety of contexts to organize and establish our findings in a progressive matter. We found that there was overlap between the social, political, technical, and economic contexts we defined. Easton is a historical city that has continued to inaugurate a new artistic image that associates well with its community. With the Simon Silk Mill epitomizing this identification, the historical landmark's policies intertwine with the social needs and wants of the community and business owners, like Mr. Hampton and his art studio.

There are several features of Brick + Mortar's studio and gallery that lack energy efficiency, but make up for it in visual benefits. This tradeoff between aesthetics and energy efficiency has been the core of our study. It touches on all contexts of social, political, technical, and economic. Our in-depth investigation has developed the necessary information to pursue an economic analysis that can evaluate the cost of potential energy-related alternatives. This information can be used to explain the 'energy efficiency' side of the trade-off. 'Aesthetics' are purely opinionative and is for Mr. Hampton to decide. Therefore, it is at his discretion for what alternatives, if any, are eventually implemented.

Next Steps:

The next stage in this Brick + Mortar urban revitalization project is securing funding and time to investigate the solutions we proposed and hopefully implement some. We quickly realized that performing an effective, comprehensive energy analysis requires a substantial amount of time and resources. As we gathered information throughout the semester, we tried to contextualize it into something that can be of benefit to Brick + Mortar. A project of this scope would require a significant amount of time. With the information becoming progressively denser, we thought about how we can make this project most effective. We decided that given our timeframe, we should direct our information to a new audience: a future group of Engineering Studies capstone students. By framing this project for future students and providing them with the necessary background information to understand the project, we hope that our energy analysis is beneficial to them. This development project would better be served as a year long project instead of a semester-long project. Our hope is that by after one semester of work, we were able to gather enough information for a future group of students to perform a true economic analysis to then provide the results to Mr. Hampton. In our report, we offer technical

information, suggestions, and background knowledge that is necessary to know for future references.

When future groups of students conduct their analysis on Brick + Mortar, or any other revitalized building in Easton, they can use our work as a resource. We concluded that a payback analysis would be the most effective for this project. A payback analysis determines whether our proposed technical solutions will pay for themselves in a certain amount of time. This type of economic analysis would be the most effective for future attempts at this project because it would ensure that investments are justifiable by energy cost savings. For a payback analysis to be useful we would need to know the future cash flows that these investments bring in, in addition to understanding Brick + Mortar's future profits and revenues. An increase in time and budget would allow future groups to use more sophisticated technologies to investigate our alternative solutions further. Tools to measure air velocity, for example, would be effective in improving energy efficiency by accurately measuring the amount of air leaking through the windows, walls, and ceilings. An important aspect for future groups to recognize is that regardless of which technical solutions are decided on or what level of energy efficiency is achieved, the owners of Brick + Mortar are the community members being served and therefore their needs and wants supersede any of our propositions.

Challenges:

Urban revitalization is an endeavor that houses many difficulties and obstacles. Our case study with Brick + Mortar allowed for a more confined perspective and inside look on such difficulties. A 135 year old silk mill building turned art gallery and studio provided us with the necessary platform to preview the final product of a renewed and revitalized historical structure. In our attempt to hone in on the challenges that have been bearing a great amount of weight on

Brick + Mortar's financial expenses, we identified a variety of challenges that we encountered and future students will encounter.

Upon our first meeting with Mr. Hampton, we immediately noticed his passion for art. He chose to occupy the space at the silk mill due to its aged appeal and artistic atmosphere, two characteristics that continue to be of great importance to him. Unfortunately, the appeal of the aged infrastructure comes with many inevitable features that bear weight on their finances. Given the age of the silk mill, the buildings are energy inefficient. The windows and garage doors allow for noticeable drafts making it difficult to limit heat usage during winter months. Replacing the poorly insulated windows proves to be near impossible due to political barriers from the mill's historical significance. Additionally, an exposed HVAC system allows for frequent dust collection that prevents the system from running efficiently. It's aesthetically pleasing, however it does not present much practicality given the particular work Mr. Hampton does. The main challenges going forward are the mill's historical significance preventing certain modifications and the owner's value for aesthetics. Our framework can help limit these barriers for future groups on the project. By having a contextual understanding of Brick + Mortar and the Silk Mill, students can focus more on their analyses and waste less time facing challenges they didn't realize were there.

Bibliography

Art and Nature Converge: Welcome to the Karl Stirner Arts Trail. (n.d.) Retrieved November 15, 2018, from <https://karlstirnerartstrail.org/>.

Beall, Edson. Weekly List. National Parks Service. (January 23, 2015). Retrieved November 15, 2018, from <https://www.nps.gov/nr/listings/20150123.htm>.

Briga-Sá, Ana, David Nascimento, Nuno Teixeira, Jorge Pinto, Fernando Caldeira, Humberto Varum, and Anabela Paiva. "Textile Waste as an Alternative Thermal Insulation Building Material Solution." *Construction and Building Materials* 38 (January 2013): 155-60.

doi:10.1016/j.conbuildmat.2012.08.037.

Concrete Slab-on-ground and Energy Efficiency. (January 2011). Retrieved December 3, 2018, from https://www.ccaa.com.au/imis_prod/documents/Library%20Documents/CCAA%20Technical%20Publications/CCAA%20Briefings/Briefing17.pdf

Connexions Gallery. (n.d.). Retrieved November 15, 2018, from <http://www.connexionsgallery.com/about-us.html>.

Easton Main Street Initiative. (n.d.). Retrieved November 15, 2018. <http://www.eastonmainstreet.org/about-downtown/history/>.

Energy Efficiency in Log Homes. (n.d.). Department of Energy. Retrieved December 04, 2018, from <https://www.energy.gov/energysaver/types-homes/energy-efficiency-log-homes>.

FirstEnergy Corp. Retrieved November 20, 2018, from https://firstenergycorp.com/customer_choice/pennsylvania/met-ed_penelec/your_price_to_compare.html.

Gago, E.j., T. Muneer, M. Knez, and H. Köster. "Natural Light Controls and Guides in Buildings. Energy Saving for Electrical Lighting, Reduction of Cooling Load." *Renewable and Sustainable Energy Reviews* 41 (2015): 1-13. Retrieved December 3, 2018. doi:10.1016/j.rser.2014.08.002.

Graham, Carl Ian. "High-Performance HVAC ." Optimize Energy Use | WBDG Whole Building Design Guide. July 11, 2016. Retrieved December 04, 2018, from <https://www.wbdg.org/resources/high-performance-hvac>.

Heating, Ventilation and Air Conditioning (HVAC) Energy Efficiency. (December 2017). Carbon Footprint Calculator for SMEs – Carbon Trust. Retrieved December 04, 2018, from <https://www.carbontrust.com/resources/guides/energy-efficiency/heating-ventilation-and-air-conditioning-hvac/>.

How Energy-Efficient Light Bulbs Compare with Traditional Incandescents. Department of Energy. Retrieved November 20, 2018, from <https://www.energy.gov/energysaver/save-electricity-and-fuel/lighting-choices-save-you-money/how-energy-efficient-light>.

Household Energy Use in Pennsylvania (2009). Retrieved December 3, 2018, from https://www.eia.gov/consumption/residential/reports/2009/state_briefs/pdf/PA.pdf

HVAC Equipment. (November 15, 2005). Retrieved December 3, 2018, from <http://people.tamu.edu/~i-choudhury/note13.ppt>

Lehigh Valley Development Priorities (2014). Retrieved November 20, 2018, from <http://www.lehighvalley.org/wp-content/uploads/2014/05/LVEDC-Report-0207.pdf>

Lippincott, G. (n.d.). *Silk: A Creative Community* (Rep.). Retrieved October 04, 2018, from City of Easton, Lafayette College website: <https://www.easton-pa.com/ced/silkmillfinalreport.pdf>

Mercantile Home. Retrieved November 15, 2018, from <https://mercantile-home.myshopify.com/pages/about-us>.

National Historic Preservation Act of 1966 (16USC470). (n.d.). National Parks Service. Retrieved November 15, 2018. <https://www.nps.gov/history/local-law/nhpa1966.htm>.

O'Doherty, Brian, and Thomas McEvelley. *INSIDE THE WHITE CUBE*. SANTA MONICA, SAN FRANCISCO: LAPIS PR., 1986.

Philips 420208 Halogen PAR30L 75 Watt. Amazon. Retrieved November 20, 2018. https://www.amazon.com/Philips-420208-Halogen-PAR30L-Equivalent/dp/B009ZR5BI0/ref=sr_1_3?ie=UTF8&qid=1542665693&sr=8-3&keywords=philips+75w+halogen.

T219 Trac Head – Trac-Master® PAR38 Delta 200 Series® Trac Head. (n.d.). AcuityBrands. Retrieved November 20, 2018, from <https://www.acuitybrands.com/products/detail/657906/juno/t219-trac-head/trac-master-par38-delta-200-series-trac-head>.

Tarmy, James. “Why Do So Many Art Galleries Lose Money?” Bloomberg.com. July 30, 2015. Retrieved November 15, 2018. <https://www.bloomberg.com/news/articles/2015-07-30/why-do-so-many-art-galleries-lose-money->.

Tax Incentives-Technical Preservation Services, National Park Service. (n.d.). National Parks Service. Retrieved November 20, 2018. <https://www.nps.gov/tps/tax-incentives.htm>.

The Arts Community of Easton. (n.d.). Retrieved November 15, 2018. https://www.eastonart.org/?page_id=24.

Touch ‘n Foam 600 Ft. Board Polyurethane 2-Component Spray Foam Kit. (n.d.). The Home Depot. Retrieved November 20, 2018. <https://www.homedepot.com/p/Touch-n-Foam-600-ft-Board-Polyurethane-2-Component-Spray-Foam-Kit-4006062600/204962775>.

Window Types and Technologies. (n.d.). Department of Energy. Retrieved December 04, 2018. <https://www.energy.gov/energysaver/window-types-and-technologies>.

