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Old to green: A green renovation to a historic home and its important role in the current green building era

Stacey Ann Hefley

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OLD TO GREEN:
A GREEN RENOVATION TO A HISTORIC HOME AND ITS IMPORTANT ROLE IN THE CURRENT GREEN BUILDING ERA

by

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Thesis

Submitted to the Department of Interior Design

Eastern Michigan University

in partial fulfillment of the requirements

for a degree of

MASTER OF SCIENCE

in

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ABSTRACT

The purpose of this study is to identify the basic components of a green renovation project in accordance with sustainable design principles and to exemplify the applicability of each component of a historic home. The focus on historic homes in particular is to explore the important role they can play in the sustainable home building industry. With so much attention focusing on new home construction nowadays, there is concern that the critical contribution historic homes can make to the environment is being overlooked. Their role in the building design and construction industry is not only beneficial to sustain our environment, but also significant to preserving the history of the nation in general. The methodology for green renovation discussed in this study is verified through a case study in order to demonstrate the environmentally sustainable potential of historic homes. The case study serves to prove that an outdated and depreciated house can be transformed into a healthy, efficient, and environmentally conscious home while still embracing its primitive sustainability and original integrity.
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CHAPTER 1: Introduction

“...we must at the outset take note of the countries and climates in which buildings are built”
– Vitruvius, Architect, 110 BC

For thousands of years sustainable buildings have emerged out of necessity: climatically appropriate, in tune with nature, and derived from a sense of place. Only after the Industrial Revolution did the mainstay of ancient architectural principles begin to disappear. As the nation approaches its one hundred year hiatus from vernacular architecture,¹ it’s beginning to see the effects of an urban landscape with no environmental, cultural, or historical context. In the late twentieth century, Diana Lopez Barnett summarized, in her book *A primer on Sustainable Building*, what so many in the building industry are beginning to realize:

It is only in the past century or so, as cheap energy, large sheets of glass, and air conditioning appeared, that architecture lost its moorings and forgot the ancient truth that the most important building covenants are dictated by the earth. A building designed to heed its surroundings will naturally be more efficient and will make elegant and frugal use of local materials. (Barnett, 1995, p.14)

In the past century, buildings have used technology to defy nature, instead of accepting limits set forth by their surroundings. Most architects, designers, builders, and other industry professionals of the machine era were blinded by the technological blitz occurring around them. With readily available materials and fewer building constraints, the built environment,

¹ Vernacular architecture is a term used to categorize methods of construction which use locally available resources and traditions to address local needs. Vernacular architecture tends to evolve over time to reflect the environmental, cultural, and historical context in which it exists.
corrupted by the human agenda, disregarded the natural environment almost entirely.

Honoring ancient principles and harmonizing them with new age concepts can result in an ideal level of integrated design. Any noteworthy city, small or large, throughout the world is woven with many different layers including history, culture, nature, and sense of place; many of these layers are represented by historic buildings and landmarks. The building industry should be committed to maintaining the urban fabric within our nation’s cities. However, the challenge with this kind of maintenance is creating harmony between an established urban context and social, economical, technological, and ecological change. In the years following the Industrial Revolution, new buildings showed little architectural merit, and existing architectural value was ignored. Historic buildings were often viewed as outdated, depreciated buildings and were impulsively torn down. New buildings were erected in their place, ones that favored current technology and were considered the buildings of the future. This concept of a future urban landscape required little from the natural environment; so it gave little in return.

A built environment that had little regard for nature or its existing surroundings did not flourish for too long. Environmental issues such as air pollution, global warming, population growth, landfill shortage, deforestation, and so on were increasingly exploited through literature and media. Statistics began to identify buildings, placing the highest demand on the environment, wasting water and energy, rapidly developing land, and consuming resources. Building industry professionals began to realize that the destructive path their industry had taken was dictated by ever-changing technology and created a constant need for something new. It was upon this awakening that “Green Building” was introduced. “Although this new architecture is difficult to describe in a sentence or two, its
overall goal is to produce buildings that take less from the earth and give more to people” (Barnett, 1995, p. 2).

**Significance of the Study**

As the building industry becomes infiltrated with the label “green,” there is a concern that the true meaning of this term has gotten lost in translation. So many companies label their products and services as “green” that the merit behind these labels is uncertain. Each company offers its own definition of the word and most seem justified at first glance, but almost all require further investigation. It is a concept called “Greenwashing” and it’s “…when a company or organization spends more time and money claiming to be 'green' through advertising and marketing than actually implementing business practices that minimize environmental impact” (The EnviroMedia Greenwashing Index, 2009).

John D. Wagner makes reference to this concept of greenwashing in his book *Green Remodeling*:

a paint brush manufacturer that uses plastic handles may claim its products are green because the use of plastic avoids the need to harvest wood, while a manufacturer that uses wood handles may claim that its handles avoid the use of non-biodegradable plastic. (Wagner, 2008, p. 6)

Before purchasing anything labeled “green”, a sensitive buyer should understand every aspect of the product including how it was made, where it was made, what it was made from, how it will be used, and what will happen to it after use. A good investigation should reveal which aspects are green, which are not, and if sustainability outweighs the consumption. If a consumer decides to buy green, it is very important that he or she is educated on the matter
since it is up to the consumers to determine which manufacturers are really reducing their environmental footprint.

The home building industry may be one of the worst offenders when it comes to inconclusively defining the term “green”. Some home builders will implement energy-saving equipment and recycled materials and label the home as “green”. While these items may contribute something to the environment, the real question is if the positive contributions outweigh the oversight of many basic criteria for sustainable housing. Current literature on sustainability such as LEED for Homes, published by the United States Green Building Council (USGBC) in 2008, describes these criteria as:

- location;
- community and connectivity;
- lot size;
- low-impact landscaping;
- square footage;
- orientation;
- proportion of interior spaces;
- environmentally conscious regional materials;
- quality construction; and
- natural ventilation and proper window to wall ratios.

If a potential homeowner is interested in a house that will have a positive impact on the environment, then he or she needs to understand the basic design principles that have existed within homes for centuries. These principles allow the structure to sustain even after new technology becomes outdated. Sarah Susanka touches upon this issue in The Not So Big
House:

It seems as though our visions of the house of the future are defined by the technology of the moment: The minute the technology is out-of-date, so too is the style...each of these technologies has influenced the building forms of today, but when a house is designed solely with technology in mind, the result is a structural equivalent of a fad. (Susanka, 2001, p. 178)

Basic design principles for new houses that have been proven most successful embody much more than current building materials and methods. Frank Lloyd Wright, one of the most influential architects in the last century, was known for designing with these indefinite principles in mind. Wright envisioned Usonian\(^2\) houses designed to integrate themselves easily with their surroundings, use quality craftsmanship and natural materials, and create comfortable living spaces at a human-scale (see Appendix A, Image 1).

Wright's Usonian houses remain among the most successful interpretations of the house of the future. The reason these houses have aged well is that they were designed for the human beings who lived in them, not for the technology of the time. (Susanka, 2001, p. 179)

Today, the benchmark for residential design includes square footage, number of rooms, types of equipment or appliances, and other things that hold little merit for an adequate living space (see Appendix A, Image 2). Much technological advancement has dictated the design of a home. Air conditioning has led to very little consideration for

\(^2\) Usonian was a term Frank Lloyd Write used often when describing the architecture of the United States. For Wright the word came from *Usonia*, Samuel Butler's visionary book on a new America. (Susanka, 2001, p.178)
building orientation, window placement or passive cooling. As the dependency on automobiles increased, garage doors appeared on the facade of many houses, dramatically changing the look and layout. Allowing new technology to dictate design has taken a level of integration out of homes. Integrated design in a home includes regard for its surroundings, including the natural environment. The loss of this consciousness is, perhaps, why homes now put a heavy burden on their environment.

The built environment currently holds a certain level of contempt for the natural one, and this phenomenon is reaching controversial levels and is grabbing the attention of the general population. Perhaps the ethos of consumerism, looking toward the new and disregarding the old, has finally taken its toll on our nation. In terms of shaping the future of the built environment, maybe one should not just be looking forward. Instead, we need to look all around, consider what has been done, what needs to happen, and, most important; what already exists.

Reusing any existing home can be beneficial to the environment; however, his study will focus on historic homes. More specifically, historic homes are homes that were built before the exploitation of mass production and possess certain historical significance.

According to the National Register of Historic Places,

The quality of significance in American history, architecture, archeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association (National Register of Historic Places, 2008)

There is a unique benefit that historic homes have toward the environment that helps identify
them as primitively green homes. Primitively green homes are ones that make a positive contribution to the environment even before new green materials and technology are applied. Every homeowner, future buyer, builder, and design professional should recognize important contributions of a primitively green home, such as:

1. protecting historical significance of a community;
2. alleviating new construction and suburban sprawl;
3. harvesting of embodied energy.

History and sustainability go hand in hand. Without the presence of history, people would feel no connection with their surroundings, and that would increase the constant desire for something new. For example, new homes built in the late twentieth century were dictated by current technology and a demand for square footage. Those designs are repeated over and over again in subdivisions that resemble nothing more than “... a collection of massive storage containers for people.” (Susanka, 2001, p. 9) Renovations and retrofits to historic homes can update them with new technology and materials while retaining their unique qualities. The individuality historic homes possess can create a certain appreciation among their inhabitants, which will most likely result in the house being preserved. The prolonging of its existence develops “…intertemporal connections—essential connections between the current inhabitants and the people who came before and those who will come along in the future” (Beatley, 2004, p. 53).

Historic homes not only establish connections between the house and its inhabitants but they have an important relationship with entire neighborhoods and communities. Historic homes help define the local culture and establish a sense of place. When buildings are given a value that is not monetary and has little to do with the real estate market, it puts them at
lower risk of being destroyed. Historic homes are usually valued and preserved by communities that support a more sustainable way of life, compared to their suburban counterparts. Richard Franko describes this concept as

...what some people call 'low-impact development.' These communities conserve a substantial amount of open land by clustering houses in walkable neighborhoods. They reduce the surface area paved with impervious materials and use a variety of techniques to reduce stormwater runoff and protect wildlife and natural settings. (Franko, 2007, p. 4)

Although Franko is referencing to a modern mixed-use community development, that is a current response to the repetitive subdivisions of the 20th Century (see Appendix A, Image 3), these new developments resemble communities that existed before the Industrial Revolution and the invention of the automobile (see Appendix A, Image 4). Rehabilitating and preserving historic homes helps maintain vitality in communities and, therefore, further sustain their “low-impact” relationship with the environment. If a community has an agenda that involves preserving valuable homes and buildings, there is less likely to be unnecessary demolition that results in new construction.

Reuse is the key element to sustainability. Reusing historic homes and retrofitting them with current environmental know-how could be the most effective green building initiative. This thought was rightfully presented at the 2009 International Builders Show where experts stated, “Industry research indicates that even the most aggressive efficiency goals for new homes won't make a dent in overall energy consumption. Instead, remodeling and retrofitting the nation's older homes is by far the more efficient solution” (Nations
Building News, 2009). Indeed, the majority of homes in existence today were built more than fifty years ago, and simple arithmetic can establish that these existing homes contribute to over half the greenhouse gas emissions from homes. Reusing these homes, instead of replacing them, can save energy and reduce resource consumption. “We know that one immediate savings is reaped in the form of embodied energy—every brick left standing is one less that requires energy to fire” (and to transport and put into place) (Beatley, 2004, p. 69).

**Problems Addressed in the Study**

Today new homes are being labeled “green.” The energy and resource consumption that comes with the construction of new homes can oftentimes refute their green features. An abundance of new construction is careless when countless historic homes exist as potential candidates for a green retrofit. By fostering the primitive green qualities that exist in historic homes and applying current technology, rather than building an entire new home, there will be a far greater contribution to the environment.

Current green initiatives and literature written on green homes and green renovations do not generally address historic homes and their potential involvement in the green building movement. There is not enough recognition of retrofitting historic homes with new green materials and methods, and consequently maintaining their implicit sustainability. There needs to be a better understanding of primitively green characteristics of historic homes and how they can be used as a foundation for an up-to-date, efficient, and environmentally friendly home.

Understanding a historic home’s unique qualities also requires a broader sense of the connection between history and the new trend of sustaining the environment. History brings
us integrated design, continuous contribution to existing communities and infrastructure, and establishes identity and a sense of place. Sustaining history provides us with avenues to environmental protection. Combining ancient principles with current technology provides a level of integrated green design that really can have a greater impact on the environment.

**Purpose of the Study**

The United States Green Building Council (USGBC), the most recognized green building organization, has published rating systems such as Leadership in Energy and Environmental Design (LEED) for Homes and LEED for Existing Buildings. However, neither rating system gives special consideration to the renovation of existing homes. LEED rating systems are trade guidelines and can be very hard to understand. Applying the guidelines and certifying a home can be both complicated and costly. Beyond this organization, there are various other “how to” books on green home building, and several focus on green remodeling in particular.

Unlike most books on green remodeling, this study focuses on historic homes in particular. Most current literature explains, in great detail, particular materials and methods involved in a green renovation. This study addresses a broader scope, identifying the fundamentals of sustainability that exist within historic homes, as well as providing an overview of new green technology that can be applied. It attempts to prove that the fundamentals of sustainability and new age materials/methods go hand in hand when creating a truly green home. The USGBC and American Society of Interior Designers (ASID) reference the idea of green integrated design in their guidelines for residential remodeling, *REGREEN*, by stating, “In green building, it is rarely a single product or building component
or a collection of attributes that result in a building being labeled 'green'" (USGBC, Regreen p.9) The important contributions of primitively green homes, previously discussed, are reason enough to want to preserve historic homes. A green retrofit that applies appropriate green building materials and methods, however, will make historic homes even more valuable to the built and natural environment.

Although historic homes can inherently promote a more sustainable way of life, they must also demonstrate some of the same green potential present in new green homes or they will be considered outdated and will depreciate. This study will investigate which current green materials and methods can be retrofitted into a historic home. It will also investigate what methods of approach, for each method, are most appropriate when greening a historic home. No matter what product, technique, or system is being described, when dealing with new green technology, almost everything can be categorized into basic areas of concern that exist in a home: These categories include

1. design and layout;
2. a low impact site;
3. water efficiency;
4. building envelope and energy efficiency;
5. finishes and furniture.

By applying field research, this study will provide a basic outline of the most applicable materials and methods for each category. When dealing with sometimes rigorous existing conditions, it is best to identify the materials and methods that are the most feasible and have the greatest impact.

Some homeowners and potential buyers are not aware of what a green retrofit to a
true historic home entails, and they see historic homes only as out-dated and having no place in the green building movement. Many people wonder if it is possible to transform an old out-dated house into a healthy and environmentally conscious home, while making it functional and beautiful. In support of the validity of this study, a case study is being conducted based on its relevance to the topic, including

1. protecting historical significance of a community – architectural value and individuality that creates a connection between the home and its inhabitants, as well as its location and contribution to community that helps to establish a sense of place;

2. alleviating new construction and suburban sprawl – quality of construction, size and proportion, integration w/ site and connectivity to surrounding amenities;

3. harvesting embodied energy – salvaging and reusing valuable materials and decreasing demolition.

The setting for this particular case study is the Village of Milford, Michigan, a historic community located about fifty miles northwest of Detroit. Milford was established in 1832 and is one of a handful of unique historic communities in the Metro Detroit Area. Historic communities demonstrate “...distinctive places worthy of our loyalty and commitment, places where we feel at home, places that inspire and uplift and stimulate us and that provide social and environmental sustenance” (Beatley, 2008, p. 2).

The variety of beautiful homes that were built more than a century ago is a great contributor to Milford’s distinctiveness. One of these homes, built in 1891, is the Coulter-Baker homestead. It is a one thousand square-foot, one and a half story, wood frame house
with a partial basement. Much of the home's original integrity has been upheld throughout the years. Since many of the old features are still intact, the house retains its quality craftsmanship and the unique characteristics that you cannot find in new homes today. The features have a great deal of historical and architectural value. The house is located within a quarter mile of Main Street, Milford’s downtown district. This location provides walkability because of the many different amenities within a half mile radius. The Coulter-Baker house is rich in history, as it paints a picture of the past as well as helps to sustain one of the town's oldest neighborhoods.

Limitations of the Study

There is no doubt that renovating an existing home rather than building new will help lower the negative impact of building activities on the environment. This study, however, focuses primarily on the unique sustainable qualities of historic homes and how a green renovation can help make a further contribution. Some municipal governments are willing to allow any home in their jurisdiction, over fifty years of age, to be labeled as a historic home. However, according to The National Register of Historic Places (2008), there is more to be considered than age. Evaluation for compliance “involves examining the property’s age, integrity, and significance” (National Register of Historic Places, 2008). Similar to The National Register, this study suggests criteria for sustainability that not all historic homes will meet, including

1. architectural integrity;
2. individuality or character;
3. contribution to community and sense of place;
4. quality craftsmanship;
5. appropriate size and proportion;
6. integration with surroundings;
7. salvageable or reusable materials.

The green building industry is not fully regulated and there are many different definitions of what it means to be a green home. It is not likely that a green retrofitted historic home can hold all the same features of a new green home; therefore, the same guidelines or rating systems cannot be applied to both. There are currently no standard guidelines for applying green practices to a historic or existing home. Although this study should not be considered as guidelines, the techniques described in this study suggest viable options based on thorough research of current green practices. The practices discussed have already been established. The goal of this study is not to detail each individual practice but rather to explain how they can be included in a green retrofit for an historic home embodied in this case study.

Because discussion of each measure taken in a green retrofit will only be given a brief overview, individual investigation of each green practice is encouraged and should be undertaken by the reader before any attempt to implement the ideas in a particular project. Available resources and published information on green products and practices are endless. It is beyond the scope of this study to address all resources available for a green renovation. Each unique project will dictate which green procedures and items are appropriate. Preserving a historic home and protecting its original integrity may limit the green strategies that can be implemented. However, the particular approaches described herein are ones that are likely to be most applicable to an average historic home. Specific products and resources mentioned in the case study should be considered appropriate for this particular project and
may not be suitable for all retrofits.

This study is meant for current homeowners, potential home buyers, design professionals, and any other audience interested in gaining insight into the value of historic homes and their role in sustaining the environment. None of the measures suggested in this study should be undertaken without consulting required licensed professionals and adhering to applicable laws and building codes. The methods described and exemplified in this study are not prescriptive and will not provide any label, certification, or documentation that states a home is “green.” This study, however, will be educational and of value to those who have a genuine interest in implementing environmental practices and those who are less concerned with the ostensible label, green home, used for marketing purposes.
Buildings account for a large portion of the total energy consumed in the U.S., and over half of that energy is consumed by residential buildings. Daniel Chiras states in his book *The New Ecological Home* that, “according to the U.S. Department of Energy, each year America's homes consume approximately one-fifth of the nation's fossil fuel energy for heating, cooling, lighting, running appliances, and a host of other purposes” (Chiras, 2004, p. 3). The negative impact of homes on the environment has not been completely overlooked. In the past decade residential green building has made its way into mainstream consciousness. However, according to *McGraw-Hill Construction* (2008), the number of green homes in the U.S, as of May 2008 has not even reached five percent.

Since the green building movement offers new technology and materials, people are likely to associate it with new homes and modern construction techniques. As such, it may be difficult for the public to understand the role older homes play in the green building movement. There are few green initiatives that exploit old homes as an important component in the green building movement. Not only is the recognition of historic homes needed, but comprehensive background information should be given regarding the contributions that sustaining historic homes will make to the environment, such as

1. protecting the historical significance of a community;
2. alleviating new construction and suburban sprawl;
3. harvesting of embodied energy.

**Protecting Historical Significance of a Community**

Some of the characteristics that give historic homes an important role in the green
building movement are deeply rooted in history. In today's culture it is first instinct to buy new rather than preserve the old. That's why it is important to understand the value of these historic notions and how historic homes are innately green homes. In his article *Breathing Life Into Historic Buildings*, Jerry Kingwell emphasizes this important recognition:

Any homeowner, business owner, or construction professional can benefit from realizing the beauty in older properties. Whether putting a property through a preservation, restoration, reconstruction, rehabilitation or renovation project, it is important to appreciate and respect the historic elements of the space. (2008, p. 1)

Characteristics that exist within a historic home create a connection between a house and its inhabitants. Furthermore, historic homes are most often integrated with their surrounding neighborhood, town, or city. This integration helps to establish a sense of place and uphold historical significance, creating an identity for our nation as a whole. It is respect and appreciation for unique and historic places that help sustain them and allow them to contribute to the current green building movement. If historical significance is overlooked or misunderstood, however, historic homes and their important sustainable qualities are at risk of being destroyed.

Imagine a group of fifth graders who take a class trip to Philadelphia to visit some of the historic landmarks that defined the birth of the country. The trip is likely to enrich their lives, leaving them with a sense of pride and understanding of where they come from and what their future could be. Upon arrival in Philadelphia, however, they find a big box mart now stands where the Liberty Bell sat, and a fast food conglomerate has assembled where Congress first met. Unfortunately for these children, a once beautiful urban landscape, rich in
history and culture, now looks the same as the suburban setting of the elementary school from which they traveled. “Do there exist man-made places that are as valuable as the nature they displaced? How about your hometown Main Street? Or Charleston? San Francisco? Few would dispute that man has proved himself capable of producing wonderful places” (Duany, p. xi). Removing valuable buildings simply to replace them with generic new construction is often a careless and extraneous act driven by mass-production and capitalism.

The United States is showered with urban landscape that embraces many historic buildings, landmarks, and neighborhoods. These sites are photographed in magazines, written about in text books, and referenced in all different kinds of media. Americans travel great distances to experience these places because they give the nation a feeling of establishment and a sense of pride. Let's say Quincy Market was paved for parking, or perhaps Bourbon Street was demolished for new luxury condominiums. The American people would be outraged. A complete disregard for maintaining history at that scale would be astounding and would destroy the nation’s identity (See Appendix A, Image 5). So what makes the disdain for history on a smaller scale acceptable?

Almost every well-established city or town is densely woven with social, historical, and cultural context. This context creates an important and defining sense of place for a city’s inhabitants. As Timothy Beatley points out in Native to Nowhere,

There is a common distinction in literature between “spaces” and “places”
Spaces are generic and nonspecific…Places have significance and meaning to us; our memories are wrapped up with them. Places are those spaces and environments [built or natural] imbued with personal and cultural meanings.

(Beatley, 2004, p. 25)
A sense of place is generated through a built environment that possesses historic precedent and human experience and is usually derived from a response to nature and the basic needs of people. Generally, people will have a greater connection to their community if they understand the history and heritage that exists there.

Historical connections, and having a sense of the people and events that have shaped the communities in which we live, are critical in making places meaningful to us, in casting the collections of buildings as home rather than just empty vessels for sleep and work. (Beatley, 2004, p. 51)

With understanding of a community comes a certain amount of respect and a desire to protect it. Nurturing a city or town and maintaining a sense of place requires careful consideration for all commercial and residential buildings. Helping to protect an individual building is more than just rehabilitating the building itself. It is an integrated part of maintaining “place.” When historical landmarks are protected and old buildings are restored, it helps maintain a traditional way of life that “…has proved to be a sustainable form of growth. It allowed us to settle the continent without bankrupting the country or destroying the countryside in the process” (Duany, 2000, p. 4) Traditional neighborhoods provide recreation, culture, and tourism, which are a result of time and effort put into maintaining the history and character that existed in the area. People do not want to spend too much time in a space that is devoid of character or any sense of place (see Appendix A, Image 6).

When a family-owned hardware store on Main Street closes its doors after eighty years of business, a sense of place is diminished. Too often local businesses are shut down by big box stores being built just outside city limits. It isn’t even that people enjoy shopping
there, it’s simply that they can sell cheaper products. People see the discount as a matter of survival, as a viable way to financially manage their life and home. Very few people take the time to investigate how those discount stores will really impact their lives and their home. However, when Main Street becomes desolate because local businesses and people begin to move outward in every direction, they become painfully aware of what has happened to their hometown.

A better understanding needs to exist among consumers in order to really diminish the destruction of “place” and willingness to inhabit the generic “space” that replaced it. Every decision must be an informed decision, and more information needs to be readily available to help people understand how the industries that they rely on and contribute to will affect their own community, culture, and environment. As a consumer nation, American people are inclined to disregard the old and move on to the new. This is a concept that seems to be integrated into every aspect of life.

In the current culture of selling new and improved versions of everything from toothpaste to electronics, the debate over buying new rather than restoring old is portrayed as a no-brainer. The construction industry is no exception. (Kingwell, 2008, p. 1)

As new and promising “green homes” begin to dominate housing in America, there is concern that the same consumer-biased concepts will be upheld. People will assume the new homes, with cutting edge technology and new materials, must be an environmental solution. They fail to realize that most new homes lack primitively green characteristics, ones that can be found in most historic homes. While extremely beneficial, new green technology cannot
always make up for a new home’s massive consumption and unnecessary demolition and destruction of farmland, community, culture, and the environment.

Historic homes usually dominate the inner ring of most American cities, towns, and villages. They are the roots to any thriving urban context small or large. In a nation obsessed with new, many of these homes sit vacant while the suburbs grow around them. This kind of abandonment helps to destroy the livelihood of established communities. There is hope in the future that demolishing a historic home or building will become the last resort, and there will no longer be a desire to abandon an existing home and build a new one outside an already established community.

**Alleviating New Construction and Suburban Sprawl**

A new home in a new suburban housing development may be advertised as “green” and may seem environmentally friendly, but it contributes to a residential building trend that has been destroying the environment for years. In the mid-twentieth century, a whirlwind of new suburban homes began to recklessly consume land, destroy natural habitats, increase hardscape, and assemble new infrastructure. These housing developments were the result of government loans directed at new single-family suburban construction projects. “Intentionally or not, the FHA and VA programs discouraged the renovation of existing housing stock, while turning their back on the construction of new row houses, mixed-use buildings, and other urban housing types” (Duany, 2000, p. 10). Not only are suburban developments completely unmindful of existing urban context, they are poorly planned and

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3 Hardscape or "hardscaping" consists of the inanimate elements of landscaping, especially any masonry work or woodwork. For instance, stone walls, concrete or brick patios, tile paths, wooden decks and wooden arbors would all be considered part of the hardscape. (http://landscaping.about.com/cs/lazylandscaping/g/hardscape.htm)

4 FHA stands for Federal Housing Administration and VA for Veterans Administration, two post-World War II loan programs that encouraged urban dispersal and was one of the founding factors of “suburbia”
lack connectivity (see Appendix A, Image 7). Also the homes are excessively large, lacking in design, value engineering, and constructed with cheap, mass-produced materials.

One of the major environmental concerns due to sprawl is lack of connectivity. Some developers will describe their new subdivisions as neighborhoods or villages, “...which is misleading, since these terms denote places that are not exclusively residential and that provide an experiential richness not available in a housing tract” (Duany, 2000 p. 5). There are three major components to suburban sprawl: big-box shopping centers, office parks, and housing subdivisions. All of these things may lie adjacent to each other, but they are almost never connected to one another. They are separated by roadways, walls, gates, and berms of landscaping (see Appendix A, Image 8). This type of municipal segregation originated from the successful “turn-of-the-century planning” and much needed zoning during the industrial revolution. One hundred years later, the black smoke has lifted and living conditions have improved considerably but still “planners have repeatedly attempted to relive that moment of glory by separating everything from everything else” (Duany, 2000 p. 10).

Continuing into the twenty-first century, a growing lack of connectivity in neighborhoods quite literally has fueled the automobile industry. In suburbia, time that is supposed to be spent in the public realm is replaced with time spent in the automobile. This dependency on automobiles is due to a number of things, the most significant being the “density of dwelling units and jobs per acre” (Franko, 2007, p. 51); in some housing subdivisions, there can be as few as two dwellings per acre. Density is reduced further by suburban homes usually running along a river of winding roadways, with no sidewalks, that can make walkability gruesome.

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5 Value engineering is used in the building industry as a term that describes lowering cost of construction by stripping a building of anything that is not purely functional, things like architectural detail.
Suburban living was meant to offer an escape from overcrowded, noisy, polluted cities. As time goes on, however, sprawl is reaching epidemic proportions and downtown districts can’t survive.

For the past fifty years, we Americans have been building a national landscape that is largely devoid of places worth caring about. Soulless subdivisions, residential 'communities' utterly lacking in communal life, strip shopping Centers, 'big Box' Chain Stores and artificially festive malls set within barren seas of parking; antiseptic office parks, ghost towns after 6 pm.; and mile upon mile of clogged roads, the only fabric tying our disassociated lives back together – is growth. (Duany, 2001, p. x).

Suburbia is digging up the roots of our nation; it is creating an unhealthy dynamic that is limiting human interaction, destroying the true meaning of community, and having a terrible impact on the environment.

Not unlike the planning of suburban neighborhoods, suburban homes tend to be poorly designed. A truly successful residential design is more than just functionality; it is an integration of human-scale proportions, architectural detail, comfortable living spaces, and a connection to its inhabitants and surroundings. Suburban homes are generally mass-produced. They give potential owners more square feet for their dollar. However, these homes lack the comfort and character that can be found in historic homes.

Today, people often describe their home by its size, 3 bedrooms, 2 baths, and 1,800 square feet. “But a house is more than square footage and the number of beds and baths. In one of the most wealthiest societies ever, many people are deeply dissatisfied with their most expensive purchase” (Susanka, 2001, p. 1). Not often is a person heard describing their house
as Victorian style with beautiful detail, lots of daylight, perfect proportions and brazenly comfortable. Instead their first instinct is to somehow describe its size.

Quality design has nothing to with size. In fact, people become disconnected with their home when they begin to feel distressed by its overwhelming proportions. A vaulted ceiling in a foyer may make a statement when you enter a home, but when the same ceiling height is carried into the family room the concept starts to become very intimidating (see Appendix A, Image 9). Comfortable space is defined by its usefulness, not its dimensions. Smaller spaces that address one task and still interact with other space in the home can make it very comfortable. For example, it is not necessary to have separate rooms for tasks such as watching television, playing a game, working on the computer, or reading a book. The appropriate amount of room required for each task can be incorporated into one appropriately designed and perfectly proportioned space.

Creating a connection between a person and their home can often go beyond proportions. “What also defines the character of a house are the details, such as a beautiful stair railing, well-crafted moldings around windows and doors, and useful, finely tailored built-ins. These details are what attract us to older homes” (Susanka p. 12). Not only is it an exorbitant act to construct new homes while old ones are being torn down for no reason, but the majority of people who live in new urban homes do not feel a connection and do not hesitate to move on to something new when it becomes available. This disconnected feeling is usually due to a lack of detail, comfortable proportions, and useful space.

Most new homes are not individually designed by an architect; instead they are mass-produced by builders and developers. Mass-production is made possible through cheap and erratic construction methods. Today, a dozen massive houses can be built and sold in the
same amount of time it took to build one house prior to mass production (see Appendix A, Image 10). While the assembly line was invented with good intentions, mass-production has spiraled out of control, destroying some of the fundamental sustainability in houses.

Not only do profuse suburban housing developments lack primitively green homes, but more keep popping up before others are sold out. This abundance of new construction is completely unnecessary. The number of single family homes built in 2005 in the U.S. was nearly 16,000,000, according to U.S. Census Bureau (2005). Unfortunately the trend continues, producing homes and planning neighborhoods in the same manner. According to the Real Estate Blog, Mortgage, and Development News, Pulte Homes, one of the top home building companies in the nation, advertised their company by saying “a participant in the Environments for Living Program, Pulte Homes Inc. offers amazing features like low VOC paint and air filtration systems. Recognized as an Energy Star partner.” While implementing new green materials and methods sounds like the essence of sustainability, people need to understand there are different meanings behind being “green” and make sure they understand the trade-offs of different green approaches. Pulte homes may offer new green materials, but the average home built by the company is around 3,000 square feet.

Using trade-offs in green building is about finding an appropriate balance in environmental consciousness. For example, a new suburban home may advertise new bamboo flooring, which a potential buyer would consider environmentally friendly because of its rapidly renewable capabilities. However, if the buyer knew that same home used somewhere around 13,000 board feet of framing lumber, the bamboo flooring might not seem like such a contribution anymore. Removing a small percentage of consumption and waste is certainly a step in the right direction, but imagine reusing a building and reducing all the
extraction, manufacturing, transporting, and installation involved in the average construction of a new home by more than fifty percent.

American homes are on average the most lavish structures to house people in the world. The materials required to build them are excessive. A typical American home measures a little over 2,000 sq. ft., requires 13,127 board feet of framing lumber, 6,212 square ft of sheathing, 4,144 sq ft. of interior wall material, 3,100 sq. ft. of roofing material, 3,060 sq. ft. of insulation, 120 lineal ft of ducting, 15 windows, 14 tons of concrete, 13 kitchen cabinets, 12 interior doors, 2 exterior doors, 1 kitchen sink, 3 toilets, 3 bathroom sinks, 2 bathtubs, 2 garage doors, 1 patio door, and 1 fireplace. (Chiras, 2000, p. 8)

All these materials continue to dissipate while historic homes sit empty and dilapidated. Historic homes not only help curb consumption, they are adequately sized, built to withhold centuries of use, and support a more sustainable lifestyle. Beyond their innate sustainability, they can be retrofitted with new “green” technology equivalent to that in a new home. Not only can they be called “green” by industry standards, but they go beyond what the average person would define as “green.” Residential developers and the new way of home building is nothing but a threat to the existing urban fabric and an inhibitor to a sustainable way of life. The way homes are being built today has become an inefficient and over-sized burden on our planet.

In the twenty-first century, the sprawl epidemic has spread so far that many U.S. cities have metropolitan areas larger than fifty miles in diameter. Most citizens, when looking for a new home, travel outward in search of the newest housing complex available that leave the
older homes in urban areas rundown and abandoned. Often, old buildings become so neglected that potential owners perceive them as too much of a hassle to repair. The homes are often left to be torn down and replaced with new construction. This massive new construction infliction on our environment is completely unnecessary and is simply part of the consumer nation attitude. Why fix something old when you can get something new? Why buy something small when it’s just as affordable to get something large? People need to change their outlook on what a home should be, or their desire for new and extravagant houses will continue to supply a need for new construction. Perhaps a moratorium on new construction is a little extreme at this point, but reusing buildings instead of just building new needs more serious consideration. Significantly reducing the amount of new construction each year will help to revive historic homes, leaving them at less risk for demolition and allowing them to help the environment.

**Harvesting of Embodied Energy**

When property values rise in certain neighborhoods for whatever reason, it puts every outdated, small, or slightly rundown house in danger of being torn down. In this kind of situation, it is likely that the property is worth far more money than the house itself. Without strict policies put in place by the local government, old rundown houses are at the mercy of developers or anyone with money and no regard for historical significance.

From Boston to Beverly Hills, the quaintest bungalows, Cap Cods, Colonials, and ranches are getting munched away in tactical real estate maneuvers known as 'bash and builds' and 'scrape-offs,' clearing the plot for gentry-friendly 'starter castles.' (Byles, 2005, p. 8)
The current trend in housing is mostly to blame for the epidemic of destruction. Houses have increased fifty percent in size in only a few decades, and every house is “up-to-date” boasting state of the art technology. In a consumer nation, bigger and better is definitely a selling point for most people. Developers and builders have no problems selling “McMansions,” especially on a prize lot. If new construction can bring in up to three times the amount paid for the lot, then developers are not going to hesitate to take it down. “It's just $3,500 for a quick bulldozer blitz, and a day or two later, voila—tabula rasa” (Byles, 2005, p. 8).

People often think that the destruction of neglected historic homes will help rejuvenate their neighborhood, allowing room for newer, more attractive houses. According to Byles, “Architecture is the only art form that society condones destroying” (2005, p.14); (see Appendix A, Image 11). Hopefully, it is simply that most people do not realize a historic home is a very valuable asset being removed from their community.

Not only has modern civilization destroyed much of the architectural fabric inherited from previous generations, creating a widening chasm between us and our past, but worse, on every continent we have adopted a culture of destruction that presages further loss. (Byles, 2005, p. 1)

When a historic structure vanishes, so does a quality of craftsmanship that is not dictated by mass production. With every piece of trim that is removed, a nation is stripped of timeless architectural detail. With every McMansion that is built, there is another reminder of an ignored approach to integrated design that values individuality and human-scale proportions. Demolition of a historic home is not just the destruction of one house; it’s a contribution to
loss of identity and sense of place on a much larger scale.

After “erase-itecture” has taken its toll on a neighborhood, all that is left standing are massive storage units for people. This very capitalist approach to a modern neighborhood redevelopment produces structures with no roots in history and no longevity toward the future. Any contributions made by these new homes are temporary and will diminish with the technology that created them. Instead of providing a solution, ultimately, this new built environment will provide an even greater problem. “A perpetual struggle… in which capital builds a physical landscape appropriate to its own condition at a particular moment in time, only to have to destroy it, usually in the course of crisis, at a subsequent point in time” (Byles, 2005, p. 18).

Not only is the significance of these old buildings ignored, but the value of its materials is forgotten as well. Many buildings are brought down with explosives or razed by bulldozers and wrecking balls, turning everything into rubble with no regard for salvaging any materials (see Appendix A, Image 12). In his article Finding a Future for Old Buildings, David Kozlowski describes a less used alternative. “Deconstruction is the dismantling or disassembling of a building and the reuse and recycling of some of the building components. It's a time consuming and labor-intensive process” (Kozlowski, 2002, p. 1). With the average demolition taking place in one to three days, most demolition companies won't give up the time for deconstruction. There are strong markets for quality materials that can be found in old buildings and it simply gets thrown away.

Saving a house in its entirety is the most effective way to harvest embodied energy in building materials. If demolition is inevitable, however, then reusing as much material as possible does make a contribution. For example, “In Madison, Wis., a whole city block has
been deconstructed to make way for a new arts district. Seven buildings were removed; 74 percent of the debris by weight has been recycled or reused” (Kozlowski, 2002, p. 1). All the materials taken from the site will require energy to travel and reinstall, or perhaps even some refurbishing will be needed to refurbish the material, but overall embodied energy will be lower than using new products.

There are several reasons why people choose to tear down historic buildings. Some are legitimate, although more often than not, the demolition is unnecessary and a tragic loss for the neighborhood. Not only is it destroying historic buildings damaging the urban and social context of a city, but there are huge ecological disadvantages.

**Current Green Initiatives and Other Literature**

So far, in the building industry, many states have yet to adopt a legal code for green building. There are still many issues to be sorted out regarding the environment and perhaps that is what is preventing a code from being adopted everywhere, or perhaps it just takes time. One thing is certain, however: this lack of authority leaves a very open playing field for anyone to publish their opinion on green building. There is an endless amount of material to be written on new green technology and green materials, but there is a concern for how much of it contributes to the true meaning of sustainability and how much is an “inconvenient trend” (Thorn, 2008). A few years back, the green movement made a breakthrough into the commercial building industry. From there it has expanded into school, government, health care, and residential design.

As people began to recognize homes in the green building movement, more literature began to surface on green homes being built across the nation and the products and technology being used in them. In the abundance of this literature, some authors are still
clinging to the ancient concepts of green. Authors like Todd Childs, in his article *Green From the Ground Up*, reference this idea,

The idea of Green living is nothing new. Until recently, it was just called good sense. Long before air conditioning, Southerners knew that higher ceilings and wider porches made for cooler houses. Historically, it has been Green practices more than Green products that have made homes work with their surroundings. (Childs, 2008, p. 1)

As previously discussed in the *Significance of the Study*, maintaining history is a platform for many ancient green practices that can really enrich the green building industry. Reusing homes is a key component to sustainability in our built environment. More literature that focuses on these historic green practices and combines them with new green technology could help consumers and individual homes make a difference.

The most currently recognized authority on green building is the United States Green Building Council (USGBC) with their nine publications of LEED Rating Systems. One of those rating systems, LEED for Homes, was released in January, 2008 and “…is a rating system that promotes the design and construction of high-performance green homes” (USGBC).

LEED for Homes focuses primarily on new homes. It provides third-party verification for home builders and “…is targeting the top 25% of new homes with best practice environmental features” (LEED for Homes, 2008, p. iv). While LEED for homes does touch on some fundamental green practices such as location, linkages, and innovative design, it mainly promotes building the most technologically advanced houses that focus primarily on
operating-energy rather than embodied energy.

“The LEED for Homes Rating System measures the overall performance of a home in eight categories” (LEED for Homes, 2008, p. iv). These categories include Innovation and Design Process, Location & Linkages, Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials & Resources, Indoor Environmental Quality, Awareness & Education. The eight categories cover some basic concepts of green building, which can be applied to all homes, new or existing. In contrast to these basic concepts, many of the credits toward certification are dedicated to implementing new technology and materials, some of which are impossible to apply to existing or historic homes.

In the near future, a LEED rating system will be released for home renovations, which will hopefully help to increase the number of green retrofits to old homes with embodied energy and primitive sustainability. The feasibility of a renovation rating system is uncertain. Can the same set of requirements be applied to such varying existing conditions?

In 2008, the USGBC and ASID (The American Society of Interior Designers) published REGREEN Residential Remodeling Guidelines. These guidelines are meant to outline the application of established green principles to home renovations. However, the guidelines do not recognize the special conditions of a renovation to a historic home.

These unique aspects of residential remodeling mean that a separate program, resources, and approach are needed for green residential remodeling. Hence, a program focused around a best practices guide, rather than a rating program, makes sense. (USGBC & ASID, 2008, p. viii)

REGREEN does an excellent job of pointing out special circumstances that will be
encountered during a green remodel. The range of tasks to be completed will vary greatly from project to project, as a remodel could encompass anything from replacing finishes, furniture, and equipment to “…gutting a whole house down to framing and rebuilding” (USGBC & ASID, 2008, p. viii). The amount of custom work is going to be higher in a remodel than new home because new homes can utilize many mass-produced products and procedures. A lot of this custom work is due to the amount of integrated design applied to retrofitting the old with the new; a generic design and construction process cannot be applied to all.

Beyond the special circumstances regarding design and construction, dealing with residential remodels will most likely require a different type of project management than building new homes. “Remodeling professionals almost always have a client; spec remodeling projects are rare” (USGBC & ASID, 2008, p. viii). Working with homeowners directly requires knowledge on how to maintain these types of client relationships. Other issues with project management may include dealing with current occupancy and having to break down construction into phases.

REGREEN guidelines are an important step to maintaining existing neighborhoods, supporting already established communities, and reducing consumption and unnecessary demolition. Very little explanation is given to the relationship between preservation and green remodeling. Green remodeling is an effort toward sustainability with respect to the way we house people in this country. By applying green remodeling to historic homes, the homes’ true potential is restored. Restoring these homes restores their contribution to social, cultural, and environmental integrity.

Green building and historic preservation is not a topic that has gone unnoticed. There
are several pieces of literature that have been published regarding this important collaboration. In Mike Jackson’s article entitled *Embodied Energy and Historic Preservation: A Needed Reassessment*, published in the Journal of Preservation Technology, he explains how attention to the embodied energy that exists in a historic home will help preservationists incorporate them into the green building movement.

Preservationists will also benefit from exploring how embodied energy calculations could be used as a more quantitative method of measuring the overall environmental benefits of building renovation versus new construction. (Jackson, 2005, p. 47)

Jackson’s research concludes that low embodied energy in a historic home renovation will contribute more to saving the environment than embodied energy in new homes.

“Sustainability-rating tools are currently using the concept of embodied energy but in a manner that does not result in equitable quantification for historic buildings” (Jackson, 2005, p. 6). Reuse is most efficient way to harvest embodied energy. For example, in LEED for New Construction, using ten percent of materials that are regionally extracted in a project won't compare to reusing even fifty percent of an entire building. Regional extraction is just a fraction of embodied energy, while reuse of materials requires no extraction, manufacturing, delivery, or installation.

There is a concern that the literature on green homes that has entered mainstream consciousness focuses on new green technology and operating-energy with not enough attention to reusing historic homes and lowering embodied energy. More awareness by homeowners, design and construction professionals, and potential home buyers is required to help green renovation to historic homes sustain our countries established communities.
It is important for historic homes to be recognized for their primitively green characteristics and historic values so that they can continue to contribute both to historic preservation and conservation of the environment. Despite their existing sustainable aspects, however, historic homes still have the opportunity to be updated with the availability of new green materials and technology. Areas of focus for implementing new green methods include

1. Design and Layout
2. Low-Impact Site
3. Water Conservation
4. Energy Efficiency and Building Envelope
5. Finishes and Furniture

Nonetheless, not every aspect of an existing building can be adapted with new green technology, but a balance of new and old can be very effective. Understanding applicable green methods and integrating them with existing sustainable characteristics can transform an outdated house into an efficient and valuable home.

**Design and Layout**

A renovation to a historic home can consist of mainly repairing and replacing certain items, but often times it requires a great deal of interior design. Reconfiguring a floor plan will often be required to transform an old layout into a functional space. This study recognizes that a successful reconfiguration of a floor plan creates interrelated space that:

- creates comfortable task oriented spaces;
- shows attention to detail;
- upholds historical integrity;
- uses materials and space efficiently.

Historic homes were built with different tasks in mind than those that are common today; therefore some rooms in older floor plans have become obsolete. In her book *The Not So Big House* Sarah Susanka recognizes the importance of reconfiguring floor plan to accommodate a modern lifestyle, saying “I quickly realized that our old house was designed for a pattern of life that was fundamentally different from the way we live today” (Susanka, 2001, p. 3). In today’s society formalities are somewhat outdated, and it’s completely acceptable to invite guests into the spaces in which people live in and play out their daily routine. Rooms such as parlors, foyers, formal living rooms, and dining rooms have no purpose in a modern household. “One hundred years later, these formal areas still define the house. It's as if visitors are presented a stage set, while the people who live there spend their time backstage” (Susanka, 2001, p. 31).

Updating old floor plans so they can compete with new homes may often require the elimination or alteration of expendable rooms (e.g., formal dining and living rooms), narrow hallways, inadequate stairways, and so on. By redesigning formal rooms and allowing for interaction, large multipurpose spaces are created (see Appendix A, Image 13). However, careful consideration must be given when joining spaces in a historic home so that the essence of the original space still remains. Good design does not entail tearing down walls until four spaces become one; in fact, that demonstrates no design at all. Simply providing a large open space does not necessarily mean it will be ideal to eat, play, and work in (see Appendix A, Image 14). Despite the original intention, historic homes are rich with detail and intimate spaces. It is important to enhance those features. Making a space larger or changing or creating a more open floor plan should not result in the creation of generic space.
Architectural features and finish will make any space more interesting; historically more attention was given to these items, rather than size or square footage. Refurbishing or replicating old woodwork, moldings, doors, hardware, furniture, and so on, that are found in historic homes, add a certain value to a house.

Most historic homes carry unique design qualities that cannot be found in today's new homes; however, not all of these homes are landmarks that are protected by laws or organizations. It’s important these homes are made useful in today’s society or they are at risk of being torn down. It is not usually feasible to try to restore a house to its original state; therefore, renovation is often preferred over preservation. In his article *Breathing new life into historic buildings*, J. Kingwell discusses the purpose of preservation, “Preservation is the act of maintaining or repairing the space to protect against change. Historic preservation projects generally frown on any improvements or modernization in respect to the building itself or technological aspects” (Kingwell, 2008, p. 1). Although precise preservation and restoration is important in some notable projects, in most it can simply create a home that does not accommodate a modern lifestyle. The house becomes undesirable to today’s buyers, putting it at risk for demolition.

When dealing with most historic homes, renovation is a more practical approach to sustaining the home than preservation. Kingwell compares the two different methods,

Renovation of an historical space is quite a different process [than preservation]. In this situation, the historical space is used as the backbone of the project...Honoring the true beauty of an old space and emphasizing its historic elements are essential in a renovation project. (Kingwell, 2008, p. 1)
Any modifications to the floor plan and replacing of materials and equipment during a renovation has to be balanced with maintaining historical integrity.

Before renovating a historic home it is important to gather as much information as possible: photographs, drawings, blueprints, maps, anything that will help clue one in on the history and style of the home. Learning about the history, significance, or unique traits that a house has or had will help to honor its true beauty during a renovation. It is easiest to start at a historical society. Most communities have them, and they contain records and photos of most historic buildings in the area. The next step would be checking out local libraries, most have some type of resource center with local information, and they often carry books written on the community, photographs of significant buildings and landmarks, or articles. David E. Kyvig recognizes the importance of historical documents in his book *Nearby History*:

Newspapers, a rich source of information about communities, [they] have been published in America since the early eighteenth century... Images offer good testaments to changes throughout the years – in the skyline, the landscape, or the texture of a neighborhood. (Kyvig, 2000, pp. 61 & 123)

Even small community libraries generally keep a record of old newspaper articles. These articles can contain lots of photos of a community. Photos, drawings, and sketches are going to portray a home's past with most accuracy. If clear photographs or drawings of a home cannot be found, it is worthwhile to research old maps to gather a general idea of how old the house is and how its footprint may have evolved. Understanding what changes were made since its construction, however, will help to balance new and old during a renovation.

It is difficult for local and state governments to keep accurate records of so many
homes. Sometimes the most valuable information can be found with the home's previous residents. Community libraries and historical societies often have directories, dating back nearly a century, listing the residents at a particular address. If previous residents or relatives of residents can be located they may have important documents, photographs, or stories to share.

Visual documents are going to be most useful when researching a home’s important historical features. Written documents and stories, however, will also offer some insight into the history and use of a home. Stories may seem at times to be just a sentimental anecdote; however, they can help paint a picture of a past life. According to Kyvig, “Some stories answer questions. What was it like to live in another time or place? Or on a more profound level: How has the meaning of “being human” changed through the years? How does being a part of a particular community affect one's sense of identity? Sometimes stories are a means of leaving record for future generation” (Kyvig, 2000, p. 41). Answering these questions such as these can help a person understand the previous generations and the homes they built. Respect for a home's past and recognition of its unique features can develop a connection between an owner and their house, giving the house greater value.
Table 1

**Historic Research Methods** (Kyvig, 2000)

<table>
<thead>
<tr>
<th>Type of Record</th>
<th>Significance</th>
<th>Source/location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maps</td>
<td>Reveals how the footprint of the house evolved (additions, demolition,</td>
<td>local, county, and state libraries, Historical</td>
</tr>
<tr>
<td></td>
<td>outbuildings, lot size, neighborhood development)</td>
<td>Society, City offices, Websites</td>
</tr>
<tr>
<td>Drawings, blueprints</td>
<td>Gives exact details of the home's layout and construction</td>
<td>local, county, and state libraries, Historical</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Society, City offices</td>
</tr>
<tr>
<td>Photographs</td>
<td>Reveals most detail in design, construction, style, layout, etc.</td>
<td>Historical Society, Old Newspapers on Microfilm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Library)</td>
</tr>
<tr>
<td>Articles, publications</td>
<td>Reveals any ties to the community or insight into the lives of its previous</td>
<td>Historical Society, Old Newspapers on Microfilm</td>
</tr>
<tr>
<td></td>
<td>inhabitants, a better understanding of its historical significance</td>
<td>(Library)</td>
</tr>
<tr>
<td>Personal Sentiments</td>
<td>Pieces of information that help tell a story about a home making it more</td>
<td>Past Residents, Historical Society, County Courthouse,</td>
</tr>
<tr>
<td></td>
<td>interesting</td>
<td>Old directories (Library)</td>
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</tbody>
</table>

Design goals can have a lot to do with aesthetics and functionality of the home; however, the design and layout phase of a green project should also focus on conservation. “Anytime you can reuse waste from your remodeling project or from someone else's construction or deconstruction project, you help conserve resources, save landfill space, decrease disposal costs, and avoid costs of new materials” (Johnston, 2004, p. 177). Decisions must be made up front to determine the most efficient way to dismantle and
construct during a project. Salvaging materials such as doors, hardware, cabinets, shelving, and molding, can reduce the amount of materials that will be consumed in a renovation or addition. Also these salvaged items are often higher quality and made of more valuable materials than products manufactured today. In historic homes, reusing original materials can help maintain the character and integrity of the home.

Finding areas in which materials can be reused rather than recycled or thrown away is just one aspect of an efficient design. When constructing new areas, an integrated design process is required at the beginning of a renovation and is going to allow the most opportunity for efficiency. LEED for Homes Rating System awards up to four points for integrated design projects that “actively involve all team members” in all phases of the project, including conceptual and schematic planning. Schematic design needs to consider not only current project requirements but any design requirements that may come up in the future. Even a renovation to one room should consider how that room interacts with the rest of the house, and if it will compliment future renovations in other areas. Long term design goals need to be established at the beginning of a renovation project as much as possible, developing any future ideas the owners have to avoid extra work and wasting materials.

A Low-Impact Site

When considering green strategies for a home renovation, most consideration is given to the house itself. There are several modifications that can be done to a yard that will have a notable contribution. This study summarizes some of the most applicable methods of addressing each site modification. The information has been gathered from requirements set forth by the USGBC and the American Society of Landscape Architects (ASLA). Site considerations include:
1. locations & linkages;
2. reducing heat island effect;
3. surface water management;
4. landscaping.

These are the main areas of concern for reducing the impact of the developed land on the environment. Green strategies that can be applied on a site are by no means limited to the list above, and there are many different approaches toward each item on the list. The items to address regarding a site should be approached differently for an existing or historic home as they would be for a new home. The need to implement alternative strategies will depend on the conditions of each individual project.

**Location & Linkages.** When purchasing a historic home, with the intention of a green retrofit, there are some site selection concerns to watch out for. According to the ASLA, site selection concerns include Brownfield redevelopment, protecting habitats, avoiding flood plains, and limiting disturbance of unique soil. Although it is important to look for historic properties that have been mindful of these items as much as possible, most properties with existing structures will contribute more in other areas than site selection.

Most historic homes exist within an already established community, unlike most new suburban homes. They are often constructed on cheaper, undeveloped land just outside an existing urban fabric. Historic homes are almost always located in the heart of a village, town or city. It is difficult to find a home in a historic neighborhood where 100% of the perimeter does not border previously developed land. LEED for homes awards a point for 25% of a lot

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6 Brownfields are real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant. (http://epa.gov/brownfields/)
to be bordered by previously developed land. In order to ensure connectivity, walkability,⁷ and so on, 75% of the perimeter lot bordering previously developed land is a better target to aim for. Lots that border established park or recreation land should be excluded.

Walkability is increased through density of dwellings. When purchasing a house, consider smaller lot sizes which contribute to a higher density neighborhood. Providing over a quarter of an acre of land per home is unnecessary. A small lot can usually meet the outdoor needs of many people.⁸ Most of a large lot goes unused and is simply for aesthetic purposes. Open space for children and pets to play can be found in parks and public common areas within a community.⁹ Also a higher density allows more houses to be connected to one infrastructure of sewers and water supply. In higher density communities, you will also find more opportunity for mass transit. This is always beneficial to the environment by keeping the number of automobiles per day to a minimum.

Before purchasing a home it is imperative to investigate that it is linked to enough basic amenities within a reasonable walking distance. “Basic services include but are not

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⁷ Is the measure of the overall walking conditions in an area "The extent to which the built environment is friendly to the presence of people living, shopping, visiting, enjoying or spending time in an area" (Wikipedia)

⁸ It important to provide areas for “mental restoration” outdoor space on-site that is dedicated to quiet use and contains at least four of the five following components:
  • Comfortable seating
  • Comfortable settings that respond to the microclimate (e.g., shade, windbreaks)
  • An amenity or view that encourages site users to utilize the space (e.g., water feature, art, beautiful view, pathways, and opportunities for gardening)
  • Vegetation cover that meets the requirements of the “Preserve and restore plant biomass on-site” credit
  • Mitigation of existing stressful factors, such as noise. (ASLA, 2008, p.101)

⁹ Also select a site near a park or recreation area. Most people living in dense communities rely on communities to “Provide outdoor gathering spaces of various sizes and orientations to accommodate small to large groups, for the purpose of building community and improving social ties.” People living in established communities do not need use their own lot for physical activity and social interaction. (ASLA, 2008, p.102)
limited to bank, place of worship, convenience grocery, day care, cleaners, fire station, beauty parlor, hardware store, laundry, library, medical/dental office, senior car facility, park, pharmacy, post office, restaurant, school, supermarket, theater, community center, fitness center, museum” (USGBC, 2006, p. 35). There also needs to be appropriate pedestrian walkways that can access these services without endangering any lives. The best method of approach for this is to establish a half-mile radius on a map around the site and indicate where at least 10 of these amenities are located inside the radius.

**Reducing Heat Island Effect.** Reducing impervious surfaces can help reduce the impact of heat island effect and surface water run-off on the environment. “Heat Island effect occurs when warmer temperatures are experienced in urban landscapes compared to adjacent rural areas as a result of solar energy retention on constructed surfaces” (USGBC, 2006, p. 101). Materials with a low solar reflectance index\(^{10}\) contribute greatly to Heat Island Effect by absorbing solar radiation, heating surfaces and ambient air. According to the *US Environmental Protection Agency* (2007), this has an enormous impact on the environment; “Heat islands can affect communities by increasing summertime peak energy demand, air conditioning costs, air pollution and greenhouse gas emissions, heat-related illness and mortality, and water quality” (US EPA). Pavement and other hardscapes on a site, including private driveways, sidewalks, and patios are major contributors to the heat island effect. There are several different types of pavement, shown in Table 2. Some have a higher solar reflectance index and help to reduce heat absorption of hardscapes.

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\(^{10}\) Solar Reflectance Index is a measure of a material’s ability to reject solar heat, as shown by a small temperature rise. It is defined so that a standard black (reflectance 0.05, emittance 0.90) is 0 and a standard white (reflectance 0.80, emittance 0.90) is 100. (USGBC, 2006, p.102)
Table 2

*Solar Reflectance Index (SRI) for standard Paving Materials* (USGBC, 2006, p. 93)

<table>
<thead>
<tr>
<th>Material</th>
<th>Emissivity</th>
<th>Reflectance</th>
<th>SRI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical New Gray Concrete</td>
<td>0.9</td>
<td>0.35</td>
<td>35</td>
</tr>
<tr>
<td>Typical Weathered Gray Concrete</td>
<td>0.9</td>
<td>0.2</td>
<td>19</td>
</tr>
<tr>
<td>Typical New White Concrete</td>
<td>0.9</td>
<td>0.7</td>
<td>86</td>
</tr>
<tr>
<td>Typical Weathered White Concrete</td>
<td>0.9</td>
<td>0.4</td>
<td>45</td>
</tr>
<tr>
<td>NewAsphalt</td>
<td>0.9</td>
<td>0.05</td>
<td>0</td>
</tr>
<tr>
<td>Weathered Asphalt</td>
<td>0.9</td>
<td>0.1</td>
<td>6</td>
</tr>
</tbody>
</table>

When considering laying a new driveway, sidewalk, or patio an open grid pavement system should be used; these are usually made of stone, brick, or broken up pavement use dirt, grass, or some other pervious material in between.

If an excessive amount of pavement is present on the site, removing some may be beneficial. Removing all existing pavement, however, may not balance out the heavy contribution made to the landfill or the processing it will require to transform it for another use. Trade-offs like this need to be considered: where will the concrete end up, how will it get there, and how will its end use affect the environment? If pavement exists and it does not make sense to remove it, then there is always the option of repaving it with a lighter color material, such as covering asphalt with new gray concrete. Increasing vegetative cover and shading pavement is always a logical approach that will reduce heat absorption.

The roof is another important consideration; “to maximize energy savings and minimize heat island effects, materials must exhibit a high reflectivity and high emissivity
over the life of the product” (USGBC, 2006, p. 99). Similar to non-roof surfaces, the majority of roofing materials must have a high-solar reflectance index in order to really reduce heat island effect. The color of a material can make a difference; however, the biggest contribution is going to be in the type of material and its ability to reject solar heat (See Table 2).

**Surface Water Management.** Beyond heat absorption, impervious materials used on site can produce excessive amounts of surface water runoff.

Surface water is a vehicle for transporting pollutants into our waterways, rivers, lakes, and streams. During a rainstorm or snowmelt, chemicals and sediments are conveyed into our waterways. These discharges cause significant damage to our environment and aquatic life (Stormwater Authority).
Table 3

*Solar Reflectance Index (SRI) for Typical Roofing Materials* (USGBC, 2006, p. 99)

<table>
<thead>
<tr>
<th>Example SRI Values for Generic Roofing Materials</th>
<th>Solar Reflectance</th>
<th>Infrared Emittance</th>
<th>Temperature Rise</th>
<th>Solar Reflectance Index (SRI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gray Asphalt Shingle</td>
<td>0.22</td>
<td>0.91</td>
<td>67F</td>
<td>22</td>
</tr>
<tr>
<td>Unpainted Cement Tile</td>
<td>0.25</td>
<td>0.9</td>
<td>65F</td>
<td>25</td>
</tr>
<tr>
<td>Red Clay Tile</td>
<td>0.33</td>
<td>0.9</td>
<td>58F</td>
<td>36</td>
</tr>
<tr>
<td>Aluminum Coating</td>
<td>0.61</td>
<td>0.25</td>
<td>48F</td>
<td>50</td>
</tr>
<tr>
<td>Metal Roof</td>
<td>0.72</td>
<td>0.45</td>
<td>36F</td>
<td>70</td>
</tr>
<tr>
<td>White metal roof</td>
<td>0.67</td>
<td>0.85</td>
<td>28F</td>
<td>82</td>
</tr>
<tr>
<td>White Cement Tile</td>
<td>0.73</td>
<td>0.9</td>
<td>21F</td>
<td>90</td>
</tr>
</tbody>
</table>

Runoff comes from any constructed surface, such as driveways, sidewalks, patios, decks, and roofs. Any site less than fifty percent pervious is going to dangerously contribute to surface water runoff. The main goals for surface water management are to use pervious materials, reduce paved surfaces, and to create rain gardens, retention ponds, and opportunity for surface water harvesting.

Once hardscapes are in place on a lot, creative approaches have to be taken to prevent runoff from entering storm drains. Similar to requirements for heat island effect, consider removing portions of pavement to create an open grid paving system. If no driveway exists or one is completely removed, there is the option of putting in a grass driveway. Grass driveways are a growing trend; they consist of inter-locking plastic honeycomb pavers that
allow grass to grow through each cell (see Appendix A, Image 17). The system is load bearing and each plastic cell protects the grass roots so the vegetative system stays in place and increases evaporation from open cells. Franke James, author and environmentalist, describes the effects of her new grass driveway,

I compared the stormwater runoff from our former interlock driveway versus our new green driveway and garden. I found that about 75% of the total annual runoff was diverted from the sewers and now recharges the groundwater and nourishes plants and trees. (James, 2008)

Some other approaches to reducing runoff are to “...construct multiple vegetated ditches or depressions (swales) along a driveway...” (Donath, p. 4) to help filter sediment. Another small drainage system, a french drain, consists of carving out a small strip of pavement and digging a trench to divert water elsewhere. French drains are simple and have only gravel laid at the bottom.

If possible, it is best to divert runoff from the site through bio-retention or collecting water in a small rain garden or depression in the ground that contains water tolerant plants. “In addition to managing runoff volume and reducing peak discharge rates, this process filters suspended solids and related pollutants from stormwater runoff” (SEMCOG, 2009, p. 133). The size of rain garden varies depending on the amount runoff generated on the site. A typical residential rain garden consists of a depressed area for ponding (6” maximum), 6” to 24” of composite soil, ground cover or mulch, and moisture tolerant plants.

**Landscaping.** Vegetative cover is a natural way to remedy a lot of environmental concerns on-site, including blocking solar radiation, catching rain water and limiting runoff,
protecting and restoring habitats for animals and insects, and so on (see Appendix A, Image 18). While increasing vegetation is always beneficial, it is also important to never introduce invasive plants\(^{11}\) and to remove any existing ones. Each region of the U.S. has different plants that are considered invasive; they should be identified on any existing site and replaced with native plantings. According to the United States Department of Agriculture, “these [invasive] plants are characteristically adaptable, aggressive, and have a high reproductive capacity. Their vigor combined with a lack of natural enemies often leads to outbreak populations” (United States Department of Agriculture, 2008). Outbreaks of invasive plants can weed out important vegetation that helps to maintain the natural habitat of that region.

Native vegetation that has high tolerance for drought should be implemented in gardens and flowerbeds, and those areas of landscaping should be expanded. Large vegetative areas with native plants that require less water will help reduce mowing and irrigation. The maximum amount of turf grass possible should be replaced, if not with gardens, then with some kind of grass alternative. In his article, *What kind of yard never needs mowing?* Josh Clark suggests alternatives such as *creeping perennials*, *Mondo Grass*, and *Meadow Grass*. These are all low growing plants that can handle foot traffic, rarely need to be mowed, and require minimal irrigation. Meadow grass is a popular mix of native grasses used often in the U.S. “Native grasses like sedge and buffalo grass are native grasses to North America and provide a more naturalized look to your lawn. Meadow grasses look like what you'll find in a meadow (hence the name)” (Clark, 2009).

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\(^{11}\) Invasive plants are both indigenous and non-indigenous species or strains that are characteristically adaptable, aggressive, have high reproductive capacity and tend to overturn the ecosystem in which they inhabit. Collectively they are one of the great threats to biodiversity and ecosystem stability (USGBC, 2006, p. 72).
Water Conservation

There are several different ways to approach water efficiency in a home. Several of the systems used in current green initiatives are somewhat complex and may be difficult to implement in a historic home. The most feasible way to reduce water consumption in an existing home is to replace all plumbing fixtures with low-flow fixtures. According to USGBC there can be a savings in water consumption up to 40% simply for replacing fixtures. In addition to indoor water savings, alternative approaches to landscape irrigation can save up to 20% more potable water. No matter which method is used, the intent is to “maximize water efficiency within buildings to reduce the burden on municipal water supply and wastewater systems” (USGBC, 2006, p. 139). Things to consider when addressing water saving strategies are

1. water reuse systems
2. landscape irrigation
3. indoor plumbing fixtures
4. water heaters
5. fixing leaks

Water Reuse Systems. Rainwater harvesting and graywater reuse systems can involve extensive adjustments to the current plumbing and mechanical systems that may be difficult to implement in a historic home. Rainwater harvesting is not a new concept; it is simply being reintroduced in the green building movement. “Archaeological excavations document ancient rainwater harvesting in Mesoamerica, the Mediterranean, and the Orient. Today, rainwater is harvested by both traditional technologies and optimally engineered facilities” (Heggen, 2003, p. 1). Rainwater harvesting systems can be as simple as collecting
runoff from a rooftop into a cistern or as complex as a new piping and digital monitoring system. Installing a graywater indoors will have drawbacks, since it requires a redistribution system. Collecting rainwater is an attainable goal for a residential project. It is the redistribution of the rainwater that can be very complex. Redistributing rainwater or graywater in an existing building will usually involve in-depth alteration to an existing piping system that could involve some demolishing and rebuilding in order to get necessary access. *LEED for New Construction* mentions that a recycled water system is most feasible in new construction projects saying, “If it is likely that a graywater system will be used…install dual plumbing lines during initial construction to avoid the substantial costs and difficulty in adding them later” (USGBC, 2006, p. 130).

**Landscape Irrigation.** Landscape irrigation is an area in which a traditional catch water system can be easily implemented. Ultimately it is beneficial to the environment to plant vegetation that does not require an irrigation system, but there are many technological advances in irrigation systems that are important to research if you are going to take this approach. Micro spray and drip sprinkler heads on irrigation systems are easy to install and can significantly reduce water consumption compared to traditional sprinklers. When using a hose for irrigation, even traditional nozzles can be replaced with micro-spray nozzles.

The ideal approach to landscape irrigation would be to recycle water on site and eliminate potable water altogether. “Irrigation typically uses potable water, although non-potable water (e.g. rainwater, graywater, or reclaimed water) is equally effective” (USGBC, 2006, p. 125). Outside water is most often used for vegetation; there is no need to use potable water since plants rely on rainwater naturally. There are many different options for installing a simple rainwater catch system, and thorough research should be done when deciding which
catch water system is best for a particular site. This study will not go into detail on the
different types of collection systems. Some systems, however, can be as simple as collecting
rainwater from downspouts directly into a barrel or basin and pumping it out to a hose used
for watering plants (see Appendix A, Image 19). Even this simple system can significantly
reduce potable water consumption.

**Indoor Plumbing Fixtures.** The most easily integrated approach to indoor water use
reduction in a historic home is the installation of high-efficiency toilets and water-conserving
faucets and shower heads. “A high performance shower head uses 1-1.5 gpm – up to 60
percent less water than a traditional shower head – and will pay for itself in mere months
from water-heating energy savings alone” (Johnston, 2004, p. 219). Low-flow aerators can be
fitted into existing or new faucets to keep water flowing at less than 1.5 gpm. A toilet should
use a maximum of 1.3 gpf, or a dual flush toilet should use 0.8 gpf and 1.6 gallons per flush
simultaneously. “High-efficiency toilets use 20 percent less water than a standard 1.6 gpf,
and this will save the average family of four around 1,000 gallons per year per person”
(Wagner, 2008, p. 121). It is easiest to calculate water savings by recording for each fixture
its flow rate and the daily uses per person, and comparing it to conventional flow rates. Most
projects implementing efficient fixtures should see up to 20% savings in water consumption.
More savings can be redeemed through ultra low-flow fixtures.
Table 4

*Conventional Case of Water Usage in an Average Home Based on Rates Established by USGBC (USGBC, 2006, pp. 143-144)*

<table>
<thead>
<tr>
<th>Fixture Type</th>
<th>Daily Uses</th>
<th>Flowrate (GPF) or (GPM)</th>
<th>Occupants</th>
<th>Water Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Closet</td>
<td>3</td>
<td>1.6</td>
<td>4</td>
<td>19.2</td>
</tr>
<tr>
<td>Lavatory</td>
<td>3</td>
<td>2.5gpm @ 15sec</td>
<td>4</td>
<td>7.5</td>
</tr>
<tr>
<td>Shower</td>
<td>1</td>
<td>2.5gpm @ 300sec</td>
<td>4</td>
<td>50</td>
</tr>
<tr>
<td>Kitchen Sink</td>
<td>1</td>
<td>2.5gpm @ 15sec</td>
<td>4</td>
<td>2.5</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>79.2 Gallons</strong></td>
</tr>
</tbody>
</table>

Table 5

*Low-flow Case of Water Use in an Average Home Based on Rates Established by USGBC (USGBC, 2006, pp. 143-144)*

<table>
<thead>
<tr>
<th>Fixture Type</th>
<th>Daily Uses</th>
<th>Flowrate (GPF) or (GPM)</th>
<th>Occupants</th>
<th>Water Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Closet</td>
<td>3</td>
<td>1.3</td>
<td>4</td>
<td>15.6</td>
</tr>
<tr>
<td>Lavatory</td>
<td>3</td>
<td>2.0gpm @ 15sec</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Shower</td>
<td>1</td>
<td>2.0gpm @ 300sec</td>
<td>4</td>
<td>40</td>
</tr>
<tr>
<td>Kitchen Sink</td>
<td>1</td>
<td>2.0gpm @ 15sec</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>63.6 Gallons</strong></td>
</tr>
</tbody>
</table>

**Water Heaters.** Waiting for hot water sends thousands of gallons of water down the drain every year. There are products available that can increase water efficiency and help hot water be delivered faster in a home than conventional storage tank water heaters. “An ’on
demand' hot water circulation pump can send hot water to fixtures in seconds without wasting water while waiting for it to get hot” (Johnston, 2004, p. 216). Another advantage to these tankless water heaters is the elimination of standby losses and an overall energy savings (see Energy Efficiency and Building Envelope, p. 56).

**Fixing Leaks.** A more inconspicuous water loss in a home is going to be found in unnecessary leaks. “One tenth of US household water consumption is lost through leaks from toilet valves, dripping faucets, and aging pipes. Toilets are the biggest offenders, often wasting as much as 750 gallons a month; a leaky faucet can waste as much as 300 gallons per month” (Johnston, 2004, p. 216). Frequent inspection of such equipment is recommended, and leaks should be fixed immediately. Homeowners can have trouble remembering to check for leaks. There are automatic leak monitoring systems available that can work in conjunction with water meters to alert a homeowner when there is a significant leak.

**Energy Efficiency and Building Envelope**

Before addressing all energy-related components of a home, a thorough investigation should be done on the specific methods available. It's recommended that professionals who are skilled in each specific area should be consulted before making improvements. This study will not provide detailed information on each specific method for reducing energy consumption. Instead it will provide an overview of areas where inefficiency can occur in a historic home and the general solution. Such areas include

1. HVAC equipment,
2. passive cooling,
3. lighting and appliances,
4. building envelope.
It is wise to conduct some sort of energy audit before addressing any of the areas of possible inefficiency. Energy audits are meant to assess “how much energy your home consumes and to evaluate what measures you can take to make your home more energy efficient” (U.S. Department of Energy, 2008). Energy audits on commercial buildings can be very scientific and include the use of expensive diagnostic equipment. When dealing with homes, however, important problems can be identified through a much simpler energy audit in which a trained energy auditor inspects the home and knows what to look for. Most utility companies will offer simple audits for free. For those who are familiar with building systems, many do-it-yourself energy audit programs can be found on the web. According to Kolle,

The unscientific assessment typically consists of a thorough two-to-three hour walk through, during which the auditor makes a visual inspection; takes photographs; and records information about the size of the building and specifics about the assumed efficiencies of the insulation, the appliances, and the HVAC system. (2009, p. 33)

Coming out of an audit, a homeowner should understand more about the current level of efficiency in the home. Understanding exactly how the areas of concern are to be addressed is the first step toward real energy savings.

**HVAC Equipment.** There are many different kinds of heating and cooling equipment that can be found in an older home. Although a heating and cooling expert should almost always be consulted when upgrading, it is important for homeowners to understand what kind of equipment exists in their home. Being knowledgeable on the subject will help homeowners decide what HVAC enhancements, repairs, and replacements are going to be adequate for energy savings in their home. The majority of homes in the US today are
equipped with a forced air furnace; the rest are a combination of heat pumps, boilers, and other methods of heating.

Forced air furnaces use natural gas, propane, oil, or electricity, and are controlled by a remote thermostat (see Appendix A, Image 20).

Once in operation, the burner fires in a combustion chamber and warms a heat exchanger (electric furnaces have coils much like a toaster). A blower pushes air over the heat exchanger, or coils, and hot air flows through a series of ducts and enters the home’s living spaces through registers in the floors, walls or ceiling. (Yates, 2009, p. 57)

Like a forced air system, a heat pump also has a blower that forces air into ducts (see Appendix A, Image 21). Unlike a furnace, however, a heat pump uses Freon gas to absorb heat from outside air and transfers it inside. “The Freon is pressurized, it condenses, and then it turns to hot liquid. A blower forces air across warm Freon-filled coils and through a system of ducts” (Yates, 2009, p. 59). Another type of equipment is a boiler (see Appendix A, Image 22). It has a method of heating that is slightly different from furnaces and heat pumps. Similar to a furnace, boilers use natural gas, propane, oil, or electricity that heats a combustion chamber. Instead of air, a boiler pumps water through the chamber where it heats up and enters the home through a “hydronic delivery system that can include baseboard fin-and-tube radiators, steam radiators, or in-floor radiant heating” (Yates, 2009, p. 61).

Replacing a conventional system with new green technology, such as a geothermal heating and cooling system, is often easier in new homes but can be incorporated in a retrofit as well. According to Fine Home Building Magazine, “Retrofits account for about 70% of the geothermal installations done by Michigan Energy Services” (Yates, 2009, p. 64). The easiest
way to incorporate a geothermal system into a retrofit is to connect it to the home's existing forced air system. Although this method is attainable, it can be quite complicated and expensive.

There are different pros and cons to each different heating system. It’s important that an initial audit is done first with thorough investigation before deciding the best way to optimize heating and cooling in a home. Repairing and replacing parts of an existing system so that it operates at its highest efficiency is probably going to be the most inexpensive and feasible method of updating a home's HVAC equipment. It can actually go a long way in reducing energy consumption. No matter what equipment is being installed, there are some basic guidelines to picking out a particular unit.

The USGBC promotes *Energy Star* qualified products in their LEED for homes rating system. *Energy Star* is a program regulated by the U.S. environmental Protection Agency (EPA) that continuously develops a list of all manufacturers of energy efficient qualifying products. “The ENERGY STAR Product Development (PD) teams at the U.S. Environmental Protection Agency and U.S. Department of Energy aim to transform the market for manufactured goods by expanding the availability and visibility of energy-efficient products *Energy Star*” (Energy Star, 2009). While the energy star label is an easy way to identify energy efficient equipment, not all companies that manufacture such equipment are registered with *Energy Star*. As long as equivalent energy efficiency can be proven and equipment is sized properly, it should provide a significant amount of energy savings. Even after new equipment is installed, it is recommended to have its operation efficiency checked annually by a heating and cooling professional.

Updated HVAC equipment can be installed and operating properly and there may still
be opportunity for energy loss within an air delivery system. Most often energy is escaping through a poorly sealed and insulated air delivery system. Leaks can occur in many different places within a forced air system.

Beginning at the unit itself where supply and return ducts connect there is usually a measurable amount of leakage in that area. According to Fine Homebuilding Magazine’s Energy-Smart Homes issue,

If this is the case and the blower is located in an unconditioned space (attic, crawlspace, or basement), it is bleeding out heat, or Btu, on the supply side while pulling in unconditioned air that must be warmed (or cooled and dehumidified) on the return side. (Yates, 2009, p. 56)

This area of leakage can be caulked or fixed with mastic-tape. The access panel on a unit may also offer some degree of leakage. The panel still needs to be accessed, and it should be sealed with nothing more than mastic tape that does not cover any required venting or access holes for wires.

All ducts supply or return air through a register in the wall, ceiling, or floor. These registers are another area for concern. The wall penetration may not hug the duct boot closely enough. If there is any amount of space in between the wall and the duct boot, air can slip through into the wall cavity and escape into unconditioned space. This kind of leak can be fixed by applying mastic tape or caulk around the duct boot as well as applying weather-stripping between the register and the wall, ceiling, or floor.

According to the Department of Energy, up to 40% of heat can be lost through duct leaks. Any seams or connections between ducts that are accessible should be sealed with
mastic tape or caulk. Air can not only leak out of ductwork, it can cool down if it passes through a duct that lies in unconditioned space. This type of heat loss before the air is even delivered can cause a furnace to work overtime. Insulating ducts in unconditioned spaces such as crawlspaces, attics, and basements is another huge energy saving maneuver. Some new homes are requiring insulated rigid ducts with an R-6 minimum insulation. In older homes all accessible ducts can be insulated with some type of duct board, duct wrap or flexible duct insulation (Yates, 2009, p. 58).

Passive Cooling. Installing new HVAC equipment can help efficiently deliver cool air into a home as much as warm air. Beyond the HVAC system there is other mechanical cooling that can be incorporated such as energy efficient ceiling and attic fans. Passive cooling, however, is the preferred method of cooling. Mechanical air-conditioning should be intended as a back-up rather than the constant method of keeping cool twenty-four hours a day, seven days a week.

Passive cooling refers to non-mechanical ways of cooling your home. It focuses on orientation and shading, air movement, thermal mass, and a tight building envelope. All these strategies can be complemented by mechanical means from air-conditioning to ceiling fans—but these passive elements can also work successfully on their own. (Piesse, 2009, p. 50)

It is impossible to rotate an existing house so that the majority of the glass faces north and south. Orientation is not something that can be modified. Penetrating the north and south walls with new windows is not out of the question; however, in most projects it may not be desired. The more practical approach to cooling is to shade glass surfaces from the exterior,
especially on the east and west facades. “Options for shading include pergolas,\textsuperscript{12} screens, and plantings” (Piesse, 2009, p. 51).

Screens and pergolas not only provide a sufficient amount of shading; they can also create an intimate outdoor space adjacent to the house. Adding canopies over windows and extending overhangs can help to block the appropriate amount of sun; however, these options may not be easy to incorporate into a historic home if its original style is trying to be maintained (see Appendix A, Image 23). Plants naturally absorb heat from the air that moves through them. Landscaping can act as a heat barrier for a home. Exterior shading works well because UV rays are lengthened when they pass through glass, making it impossible for them to travel back out (see Appendix A, Image 24). Heat is trapped in a house once it passes through glass; therefore, interior shades will help a little, but they simply store heat between the shade and the glass that will eventually escape and slowly heat up the interior space of a house.

One interior element to passive cooling is controlling heat with interior materials. “The floor is the easiest place to add thermal mass, which regulates heat all year long” (Piesse, 2009, p. 54). Flooring material such as concrete, stone, and tile should be installed in spaces with a significant amount of glass. Especially in spaces located on the south side of a home, excess heat can be absorbed during the day and released at night when the air is cooler.

Beyond the different ways of controlling heat absorption shading, there is ventilation and air movement to consider. A tight building envelope will help control air-infiltration and allow for cross-ventilation. A cool breeze in the evening running through a space will absorb

\textsuperscript{12} A Pergola is a structure that provides a shaded area and is made of pillars that support cross beams and a sturdy open lattice. (Wikipedia)
hot air; the greater the air movement, the more heat that will be drawn from the home. When air enters through a small low opening and leaves through a larger opening up high, ventilation is increased. There are many ways to achieve this. In a single-story space it can be achieved through double-hung windows. In an open two-story home, opening any windows on the first floor slightly and any windows on the second floor entirely will pull hot air out in minutes. In spaces with high ceilings, it is best to have windows placed down low as well as near the ceiling.

According to the *U.S. Department of Energy* (2008), water heaters consume 14% to 25% of a home's annual energy use. Most historic homes are equipped with tank-style water heaters. There are other alternatives to heating water, and it will require some research on the different types to decide which is best for a particular home. In a tank-style water heater, there can be anywhere from 20 to 40 gallons of water stored in the tank at all times. A thermostat tells the equipment when the water in the tank falls below a certain level and at that time, either through electricity, gas, or oil, the tank heats the water back to a certain temperature. If a home is using hot water only once or twice a day, then standby losses\textsuperscript{13} can have a sizable impact on energy consumption. It is crucial that the tank be insulated. If an older tank cannot be replaced it can always be fitted with an external insulating jacket. Another concern is that gas tank-style water heaters require venting to the outdoors, which means there is a draft and heat can be constantly leaking out (Yates, 2009, pp. 84-89).

Another option for heating water is a tankless or on-demand water heater. In this type of unit “water circulated through a large coil is heated only on demand using gas or electricity; there is no storage tank continuously maintaining hot water” (Energy Star, 2008,

\textsuperscript{13} Energy loss from storage tank water heaters using excessive amounts of energy to keep water hot at all times.
p. 1). Standby losses that can occur with a tank-style heater are eliminated; however, there is a limitation on the number of fixtures that can simultaneously use hot water. In order to supply numerous fixtures, a tankless water heater has to be quite large, meaning a greater input of BTU per hour. Also endless hot water can be abused and one might have to become more conscious of how long hot water is being used. If a tankless unit is running more often than is needed, energy savings can diminish, making it no more efficient than heaters with standby losses.

If choosing a conventional tank-style or tankless water heater, a comparison should be made of the two in order to decide which one is right for a particular project. Beyond selecting the right model based on the needs of the home, a unit needs to be properly sized and installed in order to save energy during operation. With new green technology on the rise, there are now less conventional solutions to water heating. For example, solar water heating is available. Like any solar power, though installation can be expensive and complicated and is not the most feasible upgrade for a historic home. Energy savings, however, can be most desirable with solar water heating.

**Lighting Fixtures and Appliances.** All equipment in a home contributes to energy consumption. It may seem that the furnace and hot water heater are the most draining pieces of equipment in the house appliances, but lighting can have a significant impact. Since appliances and lighting are purchased at retail stores, it is up to the owner to understand the energy efficient options available in each product so they are careful not to buy into any false advertising. Sorting through all the information available on these types of equipment can be overwhelming. **Energystar** certification is an easy way to recognize appliances and lighting that are guaranteed to follow EPA guidelines. The **Energystar** website provides literature and
tools to explain energy efficient equipment. Replacing old appliances with any new model is going to offer some type of energy savings; however, if time and money is going to be spent shopping for new equipment, it makes sense to research the different features available.

Energy efficiency is one of the main components of a green renovation. Evaluating and replacing equipment such a refrigerator, clothes washer, dishwasher, ceiling fans, and lighting fixtures can really contribute. Sometimes in historic homes there is a desire to salvage antique light fixtures as a way of adding and maintaining character in the home. If keeping old light fixtures, it is best to see if they are compatible with new compact fluorescent light bulbs in order to maintain some energy savings. According to DTE Energy (2009), swapping incandescent bulbs with fluorescent can save between $17 and $32 on an average electric bill.

**Building Envelope.** There are several different areas of a home's exterior shell that need to be addressed to really produce energy savings. The most prominent is going to be air-tightness; including sealing of exterior windows and doors and any leaks hidden in the construction of the house. Other exterior modifications can be made, including

a. window replacement,

b. proper insulation,

c. exterior finishes,

d. roofing.

**Window Replacement.** A renovation to a historic home is likely to encounter single pane windows that were installed decades ago. Even newer windows with insulated glass may not be performing correctly. Sometimes the sash alone may be the problem. Other
times windows may need to be completely replaced down to the rough opening. “Window replacements could save you 5% to 15% off your heating and cooling bills” (Guertin, 2009, p. 38). If the sashes themselves are not properly insulated, there could be leakage somewhere else in the wall penetration. It's crucial to seal cracked jambs, sills, trim, and deteriorating weather stripping. Following EPA guidelines and purchasing windows that are EnergyStar equivalent is an easy way to recognize the appropriate amount of insulation in a window (See Appendix A, Image 25). The USGBC also recommends in their LEED for Homes Rating System that a window-to-floor ratio\(^{14}\) of around eighteen percent should be met. This certain percentage must be achieved in order to not have too much or too little window area in a home, which could dramatically affect the heating and cooling of the home.

Historic homes are likely to retain quite a bit of their character from the windows and doors that were originally installed in the home. By replacing the windows and doors for energy purposes, it is still possible to uphold the original character (see Appendix A, Image 26). Often the moldings around windows and doors carry a certain level of detail that adds beauty to the home. It is important not to damage existing moldings when you are removing windows or doors. Original hardware can often still be present on windows and doors in historic homes. It is important to salvage and refurbish hardware so it can be installed on new windows and doors. Sometimes purchasing new windows and doors in the same material as the originals can retain some character in a historic home. If an old wood door with a half-light window is replaced with a generic aluminum door, a certain amount of character is going to be lost. It is best to replace windows and doors with ones that look similar in style and finish.

\(^{14}\) A window-to-floor ratio refers to a ratio of total, unobstructed window glass area to total floor area served by the windows, expressed as a percentage. (USGBC, 2006, p. 267)
Proper Insulation. Insulating and sealing windows, doors, and other equipment is important; however, it is equally important to insulate exterior wall cavities, attics, and under the floor (see Appendix A, Image 27). “Two main factors affect your choice of insulation, the configuration and the R-value” (Wagner, 2008, p. 62). R-value is how well the insulation resists heat flow. The higher the R-value, the better the resistance. When renovating a home, first the R-value of the existing insulation needs to be assessed. If the current R-value is below 13 in wall cavities, 19 in floors, or 30 in ceilings, then more needs to be added to properly insulate the house. R-value is not based on thickness “For example, these three [insulation] alternatives are rated R-11 and offer the same thermal protection as 1-1/2-inch-thick polyurethane board, 3-1/2-inch-thick fiberglass batts, or 4 inches of loose-fill vermiculite” (Wagner, 2008, p. 62).

Different insulation configurations include batt or blanket, rigid board, and loose fill. Batt or blanket is usually made of fiberglass and is very common in most homes built in the past fifty years or so. Batt insulation is usually faced with paper or foil and are cut to fit in between wall framing. When purchasing batt insulation, be sure that it is formaldehyde-free. Some types of batt use formaldehyde to hold the thin strands of fiberglass together. Rigid board insulation is a thinner but a very dense panel that is used to clad large surface areas. Loose fill or blown foams are a more recent innovation in insulating technology. This type of insulation has the greatest insulation properties and helps prevent mold by stopping warm moist air from entering the house. Blown foam insulation is the best option for bringing existing wall cavities in a green retrofit up to the proper r-value because it can be added to existing tight spaces. In a historic home retrofit, some of these places may be hard to access. As much insulation as possible should be added so the proper r-values are met. When
deciding on a type of insulation for a retrofit, the pros and cons of each type should be weighed to decide which is most suitable for the project.

**Exterior Finishes.** Some exterior finishes on a home can contribute to the energy consumption inside. Generally exterior surface are going to either absorb or reflect solar radiation. The materials used in a retrofit should not contribute to overheating a home. The manner in which a house keeps heat in the winter should be as important as how they keep heat out in the summer. The closeness of sun in summer months can drastically increase temperatures inside a home and therefore increase the desire to run air-conditioning around the clock. Passive cooling is by far the most environmentally conscious approach to cooling; and there are exterior surface materials that can help make passive cooling more feasible.

**Roofing.** A roof is a home's worst offender for absorption of solar radiation. Roofing materials need to be carefully evaluated. Depending on what region of the U.S., most older homes are going to have roofing materials made of asphalt, clay, wood, or slate. It is not just the type of material, however; the color of a roof has a lot to do with the amount of heat it absorbs. “A roof with black shingles reflects back just 5 percent of the sun's heat. A roof with gray shingles, however, reflects back about 20 percent of the sun's heat, and white shingles reflect around 25 percent” (Wagner, 2008, p. 190). Each type and color material has its own Solar Reflectance Index (SRI) between 0 and 100; the higher the number, the more of the sun's heat that is reflected. An easy way to spot products with an ideal SRI is to look for EnergyStar and Cool Roof Rating Council's (CCRC) seal of approval. Even if a seal is not apparent, a little bit of research should be able to reveal the SRI for any roofing materials (see Table 3 in Sustainable Site Modifications, p. 44).
Finishes and Furniture

When it comes to the interior portion of a green renovation and retrofit there is a continuously expanding market for green finishes and furniture. Before selecting any materials to implement in a renovation, a thorough analysis of the product needs to be undertaken. It is easy for a company to advertise a product as green because it can mean so many things; the fine print always needs to be read. There are a few things to consider when specifying interior items, such as

1. furniture,
2. flooring,
3. wall finishes.

Reuse should always be considered first due to its embodied energy. It has a much greater impact on sustaining the environment than any new green product. Before purchasing a product that claims to be green, a life-cycle analysis (LCA) must be done. “LCA is mainly concerned with the environmental impact of materials. It takes into account the entire process, from extracting raw materials, through processing, construction, planned lifetime maintenance, demolition, disposal and recycling” (Concrete Magazine, 2004). It is important to examine a product's green criteria before deciding to use it in a green retrofit project.

When retrofitting a historic home, a balance of new and old can help maintain the original integrity of the home. While incorporating new green materials is essential in some areas, it is also recommended to use salvaged furniture, hardware, and trim to add a certain amount of character to the interior. Beyond giving a home personality, used finishes and furnishings help reduce consumption and its overall impact on the environment. The USGBC recognizes reuse as a significant part of green building and suggests that homeowners “Reuse
building materials and products in order to reduce demand for virgin materials and to reduce waste, thereby reducing impacts associated with extraction and processing virgin resources” (2006, p. 233).

It is important to try to make reuse possible in every aspect of a green renovation; if anything can be salvaged from the existing house there is a chance it could be incorporated in a renovation. Woodwork can almost always be stripped and refinished to look almost like new. Door and window frames, trim, moldings, cabinets, railings, and so on should never be thrown away, even if they cannot be refurbished for use in a renovation. They can often be sold to salvage companies for reuse elsewhere. If a house is lacking woodwork, those same salvage companies could provide reused materials for a renovation project.

**Furniture.** It is common to find quality craftsmanship in a piece of old furniture, allowing it to last longer than new furniture. Cheap and erratic manufacturing has taken the lasting quality out of new furniture. “Gone are the days when U.S. manufacturers united to compete against the likes of Germany and Japan, pumping out high-quality goods under the protective shelter of the world's most vibrant economy” (Bartholomew, 2005, p. 1). Quality furniture that is constructed of sound materials is a notion of the past. If high quality furniture can be found today, it's at a high price. Used furniture is a fraction of the price, and the end result, after a simple refurbishing, can be just as satisfying.

**Flooring.** Floors make up a great portion of interior finishes, so it is important they demonstrate green characteristics. There are many different flooring products available that offer green attributes such as recycled content, rapidly renewable materials, certified wood, formaldehyde-free assembly, and so on. Certified wood flooring is made from wood that comes from a forest managed by the Forest Stewardship Council (FSC) that is “in accordance
with sustainable forest practices that will assure the long-term availability of these precious woods while protecting ancient, old growth forests” (Johnston, 2004, p. 297). Certified wood should be present in any type of flooring that includes a wood product in its manufacturing. Certified wood can be found in a variety of species. It is better to choose a species that is native to the region of the project rather than an exotic species. There is high consumption of transportation energy used to ship exotic wood species from their native environment.

Since historic homes are usually constructed entirely of wood, this often includes a wood floor. If a wood floor is present already, a renovation should first attempt to refurbish the existing wood rather than replace it with new. Reclaimed wood is a stylish new trend in the green building industry and is a very appropriate application to a historic home. Wood floors generally compliment the style of a historic home and can be used frequently in a renovation. Therefore, it's important that it comes from an FSC certified source that is regionally manufactured and harvested.

Rapidly renewable flooring is made from materials that replenish naturally at a fairly rapid rate. Great examples of rapidly renewable materials are bamboo and cork. According to Johnston “Bamboo can grow up to 60 feet in several months” and “cork is made from bark peeled from cork oak trees; cork oaks are never actually cut down to supply the cork” (2004, p. 297). Both these materials have many sustainable qualities and make an excellent alternative to wood. With modern technology, both materials can be manufactured into planks and finished in the same colors as many wood species. Linoleum is another flooring product that is “manufactured from natural, renewable materials such as linseed oil, pine resins, and cork” (Johnston, 2004, p. 298). It is recommended that linoleum is used in place of vinyl products that have a short life span, are harmful to the environment when disposed,
and emit harmful off-gases. Linoleum is an earth-friendly, healthy, and durable alternative to vinyl in utility rooms, bathrooms, and even kitchens.

Materials with recycled content are another viable option in a green renovation. Consumers have to pay special attention to products that claim to have recycled content. There needs to be a thorough the Life Cycle Assessment (LCA) to determine whether or not there is enough recycled content in the product to have a positive impact on the environment, or if the effects of the manufacturing outweighs the presence of recycled content. Some products, such as vinyl composite tiles, advertise recycled content that may not compensate for the harmful materials used in manufacturing vinyl. More natural products like ceramic and glass tile are good products to look for recycled content since they are durable and long-lasting.

Carpet is one of the most popular flooring options in the U.S. although there are many disadvantages to installing carpet in a home. Carpet has harmful off-gasing and stores bacteria that can cause health problems. Also the manufacturing of carpet includes harmful materials that carry environmental concerns. Carpet can offer a significant amount of recycled content by adding recycled plastic, wool, nylon, or cotton to the fibers. “It is available in broadloom or tiles; it does not differ in appearance or performance; and the price is comparable to conventional carpet. Recycled content underlayment and padding are also available” (Johnston, 2004, p. 299). When installing carpet it is important that low-emitting adhesives are used. Also choosing to install tiles instead of broadloom can save on cost and consumption in the long run. When carpet gets damaged, one tile can be replaced rather than an entire room.

Wall Finishes. The most commonly used wall finishes in a home are paint and
wallcovering. No matter what finish is selected, all products used should be researched thoroughly. It's important to carefully examine the labels for hazardous chemicals, or anything that says “warning,” “danger,” or “caution” indicating that it is most likely harmful to people and the environment.

With new technology most paint companies have developed a “low” or “no” volatile organic compound formula for paint. These paints are helpful in reducing harmful off-gassing that can occur during application and long after. Another important aspect to painting is to be efficient and not overcompensate. Purchasing paint that is known to have a quality formula will help reduce the number of coats that need to be applied. Calculating the amount of paint needed beforehand can reduce waste. Most manufacturers have information available that will help calculate how much square footage one can of paint will cover. Wall covering is most often made of vinyl and is made from very few natural materials. It's best not to incorporate wall covering in a home. If a homeowner strongly desires the use of wall covering, then there are some sustainable options.
CHAPTER 3: Research Methods

In order to identify basic components of a green renovation to a historic home and identify the applicability of each component, a case study was conducted. The study examined a single instance in which a green renovation could be conducted while still protecting historical significance. The case study was chosen based on certain criteria including:

- Age and historical integrity,
- Size and construction type,
- Existing condition, and
- Owner's project requirements.

The house selected for the case study had to be built before the exploitation of mass production, on or before the turn of the twentieth century. In accordance with the National Register of Historic, this study defines historical integrity as

The quality of significance in American history, architecture, archeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association.

(National Register of Historic Places, 2008)

The time frame in which the house was built often dictates its level of historical integrity and therefore was an important criterion in the selection of a case study.

Another important aspect of sustainability is size, and the goal was to find a house for the case study that was not excessively large. Most historic homes were built practically with
functionality in mind and very little wasted space. However, the case study was chosen based on the owner's requirements and the strong desire to utilize space. Also in an effort to exemplify a complete green renovation to a historic home it had to be reasonable in size with a feasible project scope.

The existing conditions of the home chosen for the case study were outdated and inefficient, which allowed for the proper updates to be shown. Because the house needed so many updates, all areas of a green renovation could be addressed, including design and layout, site modifications, water efficiency, energy efficiency, and furniture and finishes. It was important that the study could show one instance in which new green methods and materials are applied in all these areas and how they are carried out or installed. Demonstrating a green renovation while maintaining the historic characteristics of the home is the main focus of the study, and therefore existing historical characteristics were also a main criterion in the selection a proper case study. Any features that represent the architectural style, type of construction, or utilization of space that was apparent before mass production were to be included in the house studied.

The case study also aimed for a project scope that would focus on the basic notion of a successful renovation to a historic home. In order to be worth studying, the owner's project requirements had to be in keeping with sustainable principles. Areas of focus for the project scope were required to include creating functional and comfortable task-oriented spaces, showing attention to quality-crafted details that were present in homes before the machine age, using materials and space efficiently throughout the renovation, applying new materials and methods that would truly reduce the home's environmental impact, and also remembering to maintain historical integrity in every aspect of the renovation possible.
CHAPTER 4: Case Study of Coulter-Baker Homestead

Overview

The Coulter-Baker Homestead was built for the Coulter family in 1891 in the Village of Milford, located forty-five miles Northwest of Detroit, MI (See Appendix A, Image 28). The house is part of the North Milford Village Historic District (See Appendix A, Image 29) that includes some of the town's oldest buildings. “Milford Historical Society’s successful nomination of the North Milford Village Historic District was entered in the National Register of Historic Places on April 21, 2000” (The Milford Historical Society, 2006).

The new owners, who purchased the house from the Coulter-Baker family in 2007, were fascinated by its historic architecture and its presence in a unique historic neighborhood. However, its current floor plan was out-dated and made for a less than functional living space, and renovations were needed. Although the owners were adamant about updating the home, they also were very interested in protecting its historic integrity. Even at the sight of an old depreciated house, the owners were able to recognize its unique relationship to its surroundings and its ability to sustain over a hundred years. Incorporating sustainable building practices into the renovation of the home would not only update the house but would also help make it admissible in the market of new green homes, helping sustain its historical significance and protect it from demolition.

The owners made a list of goals for the renovation that were all-encompassing, including current needs and long term plans as well. They also laid out areas to implement green practices that were feasible in an old home and still maintained the home's historical
features. By making a list of requirements and consulting an architect and interior designer; the owners were able to draw up a plan that would address all their criteria in a functional layout that provides comfort and continuity. The idea was to take that plan and break it down into phases of construction that could be easily managed. Planning out a scope of work and breaking it down into phases helped eliminate the possibility of renovating something that would eventually be removed or replaced to save energy and materials.

Table 6

*Scope of Work*

<table>
<thead>
<tr>
<th>Design Goals</th>
<th>Green Practices</th>
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<tbody>
<tr>
<td>Create more open and comfortable layout</td>
<td>New energy efficient equipment and appliances</td>
</tr>
<tr>
<td>Transform second level into master suite with a full bath</td>
<td>Seal and insulated entire mechanical system and building envelope</td>
</tr>
<tr>
<td>New finishes in all existing interior spaces</td>
<td>Sustainable site practices</td>
</tr>
<tr>
<td>Relocate stairs to second level</td>
<td>Low-flow plumbing fixtures</td>
</tr>
<tr>
<td>Small addition onto dining room for future kitchen relocation</td>
<td>Use as much salvaged materials and furniture as possible</td>
</tr>
<tr>
<td>Transform enclosed porch into all-weather multi-purpose room</td>
<td>Any new materials and furniture should include as many green attributes as possible while still being in tune with the style of the house</td>
</tr>
<tr>
<td>Maintain and replenish architectural detail in keeping with the style of the home</td>
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</tbody>
</table>

The Coulter-Baker house is one and a half stories, approximately 1,000 square-feet, and is situated on a little less than a quarter of an acre. Before the renovation, the house had
two bedrooms on the second level (See Appendix A, Image #34), one bedroom on the first level as well as a small kitchen, dining room, living room, and full bath. The house is wood frame construction on a partial basement with a stone wall foundation. The style of the home is a derivative of Victorian Architecture, most closely related to Eastlake\textsuperscript{15} or end-of-the century Victorian due to its boxed shape and its less ornate facade. The exterior is equipped with wood siding, steep slope gable roof, and decorative porches on the front and side entrances.

No major additions have been added to the home since it was built in 1891. Minor additions included a screened-in porch that was added to the north side of the house off the kitchen. A hallway was put in upstairs to make the second bedroom accessible without having to enter through the first bedroom from the stairs. On the lower level, a large opening that was once between the living room and the parlor was filled in and the parlor became a third bedroom. A small bathroom was added in the back corner of the kitchen, making the kitchen significantly smaller. Until that bathroom was added in the 60s, the house had no bathroom inside, only a toilet in the basement that was added in the late 40s. The only stairway to the second level was located off the dining room. The stair was 2 feet wide with 8” treads and was very unsafe and uncomfortable. The only other buildings on the lot included a small shed that was recently torn down and an attached garage that was built nearly a century after the original construction of the home.

\textsuperscript{15} Charles Locke Eastlake (1836-1906) was a British architect and furniture designer. Trained by the architect Phillippe Harwick, he popularized William Morris's notions of decorative arts in the arts and crafts style, becoming one of the principal exponents of the revived "Early English" or "Modern Gothic Style" popular in Victorian Architecture.
Significance

Protecting Historical Significance. As mentioned in the overview; not many alterations had been done to the Coulter-Baker homestead since it was built. The owners found this to be a big selling point, the fact that the house had not been stripped of its original architectural detail. The presence of such original items including decorative trim, moldings, doors, windows, hardware, ornate woodwork, and built-in cabinetry gave the home a certain amount of character. Also contributing to its uniqueness was the general layout of the house. Due to its age, the layout was based more on human necessity than technology. In a historic neighborhood it is very unlikely to find any two homes that are identical because they were generally built for specific people.

The Coulter-Baker house was built for Mrs. Joseph Coulter, who was widowed after a farming accident took her husband’s life. Unable to manage the farm, located just outside the Village of Milford, on her own, the widow and her children were relocated to a small house on her brother-in-law’s property in the Village. The house was manageable in size and contained a decent size living room with a wood burning stove and a small adjacent parlor. Above the living spaces were two small bedrooms accessible from a narrow stairway off the rear wing of the house. The rear wing housed a kitchen with another wood burning stove and stairs to a partial basement.

Harry Coulter, their son, lived in the house for several decades before leaving the home to his daughter and her husband, Richard Baker. After the death of Richard Baker in 2003, the house was put up for sale for the first time since its original construction in 1891. The Daughter of Richard Baker, Judy (Baker) Clemmens, built a house with her husband on the rear portion of the land and currently resides there today. The Coulter-Baker family is
deeply rooted in Milford's history, and the new owners couldn't help but feel connected to their community through the previous inhabitants of their home. This connection developed a certain appreciation for their house and community, as well as a desire to preserve history.

**Opposing Suburban Sprawl and New Construction.** According to the Milford Historical Society, “Milford began at a point where Pettibone Creek flows into the Huron River. It started when the Ruggles Brothers, Elizur and Stanley, built a sawmill on the Huron River in 1832” (2009); (See Appendix A, Image #30). A post office was constructed soon after, and the village was incorporated in 1869. By constructing dams in the local Huron River the settlers were able to power several mills, and the village began to prosper. “The presence of the waterpower allowed Milford to become one of the earliest communities in Michigan to have a system of electric lights, in 1892” (Milford Historical Society, 2009).

Over the next century the village expanded to a population of over 6,000 and has managed to sustain its history quite well. Many buildings constructed in the mid 1800's are still standing including the sawmill. (See Appendix A, Image 31) Milford continuously tries to maintain its historic buildings and keep generic big-box stores and strip malls from entering the village and ruining its ambiance. Some time ago the people of Milford decided that their buildings were worth preserving. Those buildings and homes have only become more valuable over time, creating an increasing feeling of appreciation among the people. It is the balance of old and new and the mix of history and functionality that has successfully sustained Milford. It is those same principles that exist on a smaller scale in the preservation of each individual historic structure.

**Harvesting Embodied Energy.** The new owners were not only able to protect historical significance and reduce suburban sprawl, but they helped to reduce material
consumption by deciding to renovate an old home rather than purchase a new one. The new design for the renovation increases the usable square-footage of the house by only five hundred, removes only fifty-seven linear feet of existing walls, and replaces them with approximately 100 linear feet of new walls. Demolition of Coulter-Baker homestead, if replaced with a new green home of the exact same size and layout, would send approximately 500 linear feet of existing material to the landfill, not including flooring and other interior finishes.

During new construction, as much materials as possible were reused. All wood removed from wall partitions, trim work, or cabinetry was salvaged. Salvaged dimensional lumber was reused in new wall partitions (See Appendix A, Image 32). All moldings, whether removed or kept in place were salvaged, stripped, and refurbished. Most kitchen cabinets were kept in place, and refurbished, including hardware. Other cabinetry or trim was salvaged and reused in new construction. Some salvageable drywall pieces were kept for patching any holes made in walls during the renovation. All doors were stripped, refurbished, and relocated if needed.

**Green Renovation Strategies**

**Design/Layout.** The design intent in renovating the home was to make the overall layout more open and efficient without disregarding human-scale proportions, intimate spaces, attention to detail, and other classic design criteria. Floor plan alterations include

- Create more open and comfortable layout
- Transform second level into master suite with a full bath
- Relocate stairs to second level
- Small addition onto dining room for future kitchen relocation
• Transform enclosed porch into all-weather multi-purpose room

Other major design goals in the renovation include maintaining and replenishing original integrity and historical detail in the home, using as much salvaged materials and furniture as possible, and adding new green materials and energy efficient equipment.

The new floor plan for the Coulter-Baker homestead will convert the bedroom on the lower level back into a parlor, which will essentially open it up to the living room (See Appendix A, Image 34). Although this new space will be used mostly as a computer room and reading room, it still interacts with the living room. The two spaces combined are more useful for entertaining and joining people, but they still provide separate intimate spaces for specific tasks.

The existing stairs will be replaced with new stairs that mirror the layout of the old stairs. The location of the existing stairway was off the small dining room attached to the kitchen. The stairway door present in that room left minimal space for a comfortable set up for eating. The stairway now opens up to the parlor, which makes it less intrusive and an architectural feature in the house. The new stairway also helps open the second level up to the lower level, giving a small house the illusion of being larger than it is (See Appendix Image 35).

The back half of the house generally maintains the same layout. A small portion of wall was removed in the kitchen to open it up to the living room and dining room, again allowing it to interact with adjacent rooms creating a more multi-functional space, a concept that is more popular in this generation’s homes. The bathroom located in the rear of the house was outdated and needed a complete renovation. Since there are new bathrooms on the second level, the tub was removed from this bathroom. The space where the tub was located
was given to the kitchen in order increase work surface and make it a little more practical. The existing dining room was a confining seventy square feet; therefore, it is expanded slightly by enclosing the porch on the south side of the house. The room which previously could barely fit a four-person table now comfortably seats six. Expanding the dining room also makes it feasible to relocate the kitchen in the future, as desired by the owners. The other porch directly opposite the dining room is converted to an all-weather room. The new room is multi-purpose and can be used for casual dining and lounging and can also provide a unique and intimate space for entertaining (See Appendix A, Image 36).

The two small existing bedrooms in the upper level were converted into a master suite. One of the existing “bedrooms” that previously occupied the second level was measured at forty-two square feet, which can barely fit a full size bed. The new master suite is an appropriate size for a historic home equipped with a queen size bed, closet, wardrobe, and dresser. Attached to the room is full bath and linen closet (See Appendix A, Image 37). The existing attic above the rear portion of the house was expanded and converted to a second bedroom and full bath. The roof was raised to one-and-a half stories to match the existing second level, and dormers were added to create more usable space in the room. The conversion to a master suite and the addition of the second bedroom and bath is ideal for the owners and will greatly increase resale value.

In keeping with the main goals of the project, the new design for this house turns an outdated, non-functional, and uncomfortable layout into a desirable living space. The house's character and historical integrity are kept intact, and a proper use of space and a limit on new materials is highly regarded.
A Low-Impact Site. The Coulter-Baker homestead sits on a quarter of an acre lot; the existing site conditions included minimal hardscapes (excluding roof area) and not much vegetation (see Appendix A, Image #38). Although the owner’s requirements concentrated mostly on an interior renovation, they were interested in incorporating some earth-friendly site modifications as well. Creating a sustainable site can be very extensive; however, there are some straightforward methods that can have a significant impact on the environment that are not as complex and fairly easy to implement. The owners developed a simple landscape plan that incorporated some sustainable site modifications:

- Location and Linkages – sense of community, available amenities in ½ mile radius, walkability, infrastructure;
- Reduce heat island effect – shade existing concrete, replace roofing materials with low SRI products, replace as many hardscapes with low SRI products\(^\text{16}\);
- Reduce stormwater runoff – reduce impervious surfaces by removing driveway, incorporate only new pervious surfaces, design rain garden to collect runoff from site – collect and recycle runoff from roof for landscape irrigation; and
- Landscaping - Protect and incorporate existing vegetation, limit turf grass, introduce native vegetation.

Often people mistake Milford as a suburb of Detroit, unaware that for more than a century, miles of farmland separated the small village from the suburban sprawl of Detroit. Although Milford is relatively small and is not part of a dense urban fabric, it still offers a

\(^\text{16} \text{ Refer to Chapter 3 Reducing Heat island effect for explanation of “heat islands” and Solar Reflectance Index}
fair amount of connectivity. Milford provides a very mixed-use community, and numerous neighborhoods lie adjacent to downtown Milford, a half mile radius that offers many amenities (see Appendix, Image #39).

The house and the detached garage contributes 1,794 square feet of roof area to the site, which is why it was crucial to replace the existing asphalt shingles with metal shingles in order to achieve a sizable reduction in heat island effect (see Appendix A, Image #42). Metal shingles have an SRI of 70, which is much higher than traditional asphalt shingles, which reflect only 22 of the sun’s harmful rays. Besides the roof there were no other existing asphalt surfaces on site, so the main goal for the owners is to shade existing concrete surfaces and not to add any new hardscapes. The owners did choose to remove the concrete driveway, as previously discussed, as another way to reduce absorption of solar radiation.

No additional imperviousness will be added to the site, in place of concrete; any new walkways will consist of open grid pavement. It was also determined that removing the driveway and replacing it with a gravel one would be beneficial to reducing both surface water runoff and heat island effect. Allowing runoff water from a site to collect in a rain garden and filter naturally through vegetation is the cleanest way to return water to the earth and back into rivers, lakes, and oceans and the natural water cycle.

The size, shape, and location of the rain garden in this project were determined by an already suppressed area located on the south side of the garage (see Appendix A, Image #40). The design of the garden itself is that of an average residential rain garden. It is 6-24 inches with a layer of compost soil (usually a mixture of leaves, sand, and topsoil) covered with a layer of mulch and native moisture-tolerant plants. Soil will be tested beforehand to determine the type and amount of supplement soil that needed to be added. The lot has a
natural slope toward the rain garden and it will be supplemented with a swale that directs runoff. This particular rain garden is large enough to accommodate a lot nearly twice the size; therefore, there is very little risk for standing water so a complete infiltration method will be used instead of an under drain.

One method of recycling water is to catch runoff water from the roof and use it for landscape irrigation. A simple version of this system is implemented in the Coulter-Baker project. This type of catch water system attaches to downspouts and collects water in an above ground barrel or small cistern that is buried in the ground or hidden somewhere on site. A simple sump pump or lake pump can be used to pump the water out into a garden hose for pressurized landscape irrigation (see Appendix A, Image 41).

The Coulter-Baker project addresses a very small lot; in fact, the area of the house and the detached garage alone make up over 50% of the site (see Appendix A, Image 43). The remaining fifty percent contains some turf grass; a good portion of it, however, is a low-lying area on the south side of the garage that contains very little grass. The house sits on the Corner of First and Liberty in the heart of Milford’s historic district, so in order to maintain a somewhat conventional appearance; a strip of turf grass will remain in front of the house. A small picket fence will hide the remainder of the lot that will contain mixed native grasses. Such a small amount of turf grass in front will require minimal mowing and irrigation.

If possible, it is important to protect and use existing vegetation. This project in particular deals with an existing home, so it is easy to preserve the small amount of existing vegetation that is on the site. Besides removing a portion of turf grass, all existing vegetation is used in the site plan. Primarily the plan consists of adding numerous flowerbeds with native plants and flowers. Increasing native vegetation not only requires less irrigation but it
is also aesthetically pleasing, helps to cool the yard and house, and creates a sound barrier. These flowerbeds are to include plants native to Michigan.

**Water Conservation.** Since the house is very old it would be quite costly and difficult to install a grey water system due to the complexity of the system as previously discussed in the methodology section of this study. Water-saving strategies included in the renovation are

1. Low-Flow Toilets
2. Low-Flow Faucets
3. Low-Flow Showerhead
4. Water-Saving Equipment

Both toilets in the house are Mansfield EcoQuantum with dual flush technology. This particular model flushes solid waste at 1.6 gallons per flush (gpf) and 0.8 gpf for liquid waste. The only new lavatory faucet is a Moen 1.5 gpm low flow lavatory faucet. All existing faucets in the house were fitted with low-flow aerators which run at 1.5 gpm or less, compared to conventional fittings which run at 2.0gpm or greater. The flow rate for the shower in the master bath is 1.5, which is lower than the conventional rate of 5.0 and greater. When replacing existing conventional shower heads with low flow, compatibility with the valve must be thoroughly examined, or problems may occur.
Table 7

*Conventional Indoor Water Usage (365 Days, 2 Persons)*

<table>
<thead>
<tr>
<th>Fixture type</th>
<th>Flow Rate</th>
<th>Daily Usage (per person)</th>
<th>Gal/Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toilet</td>
<td>1.6</td>
<td>5</td>
<td>5,840</td>
</tr>
<tr>
<td>Lavatory faucet</td>
<td>2.5</td>
<td>5 (15 sec duration)</td>
<td>2,281</td>
</tr>
<tr>
<td>Shower</td>
<td>5</td>
<td>1 (300 sec duration)</td>
<td>18,250</td>
</tr>
<tr>
<td>Kitchen sink</td>
<td>2.5</td>
<td>4 (60 sec duration)</td>
<td>7,300</td>
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<tr>
<td><strong>TOTAL WATER USED</strong></td>
<td></td>
<td></td>
<td><strong>33,671</strong></td>
</tr>
</tbody>
</table>

Table 8

*Coulter-Baker Indoor Water Usage (365 Days, 2 Persons)*

<table>
<thead>
<tr>
<th>Fixture Type</th>
<th>Flow Rate</th>
<th>Daily Usage (per person)</th>
<th>Gal/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mansfield Ecoquantum Dual Flush Toilet/ 146-119</td>
<td>1.1 gpf</td>
<td>4</td>
<td>3,212</td>
</tr>
<tr>
<td>Mansfield Ecoquantum Dual Flush Toilet/ 146-119</td>
<td>1.6 gpf</td>
<td>1</td>
<td>1,168</td>
</tr>
<tr>
<td>Moen Lavatory Faucet/ 84913 Series/ and other retrofitted faucets</td>
<td>1.5</td>
<td>5 (15 sec duration)</td>
<td>1,369</td>
</tr>
<tr>
<td>Delta Shower/ RP46384</td>
<td>1.5</td>
<td>1 (300 sec duration)</td>
<td>5,475</td>
</tr>
<tr>
<td>Existing Kitchen sink with retrofit aerator</td>
<td>.5</td>
<td>4 (60 sec duration)</td>
<td>1,460</td>
</tr>
<tr>
<td><strong>TOTAL WATER USED</strong></td>
<td></td>
<td></td>
<td><strong>11,315</strong></td>
</tr>
<tr>
<td><strong>TOTAL WATER SAVINGS</strong></td>
<td></td>
<td></td>
<td><strong>67%</strong></td>
</tr>
</tbody>
</table>
Building Envelope & Energy Efficiency.

Table 9

Areas of Energy Efficiency Addressed in the Renovation

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Passive Cooling</th>
<th>Appliances &amp; Lighting</th>
<th>Building Envelope</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVAC Equipment</td>
<td>Orientation</td>
<td>Energy Star</td>
<td>Windows</td>
</tr>
<tr>
<td>Sealing &amp; Insulating</td>
<td>Shading</td>
<td>Compact Fluorescents</td>
<td>Sealing &amp; Insulating</td>
</tr>
<tr>
<td>Water Heater</td>
<td></td>
<td></td>
<td>Exterior Finishes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Roof</td>
</tr>
</tbody>
</table>

The first step in increasing energy efficiency in the Coulter-Baker Homestead was to replace out-dated equipment. The existing furnace and water heater were both over a decade old. Replacing a forced air system with a different heating and cooling system would have required replacing or adding new air delivery equipment, which the owners chose to avoid. Purchasing a new and efficient forced air furnace alone can impact on a home’s energy consumption so the owners started with that and planned to add supplemental solar heating in the future. The existing furnace was a gas-fired Heil “VG” Series manufactured in 1975; that unit was replaced with Lennox Elite G51 MP Series (see Appendix A, Image 44), an energy star qualified gas unit listed on the Energy Star gas furnace product list. According to DTE Energy, the replacement of the unit alone saved $36.49 in energy costs in January 2009 as compared to January 2005. Replacement of the old thermostat was also necessary in order to get an accurate reading of the temperature in a home as well an automatic scheduling feature that raises and lowers heat as necessary. The Coulter-Baker home is equipped with an energy...
star rated Honeywell programmable Thermostat.

Beyond the replacement of the unit itself, sealing air leaks at furnace-to-duct connection, connections between ducts, and connections at heat registers can save up to $69 annually in an average home (DTE energy). In the Coulter-Baker project high quality mastic sealant, Duct-Seal 321, was used to seal all connections between ducts as well as aluminum foil tape to seal the access panel on the air handling unit (see Appendix A, Image 45). Foam weather-stripping was used at heat registers to keep air from escaping into the wall cavity. Along with sealing, ductwork also needs to be insulated in unconditioned spaces. Half of the house sits on a crawlspace, so it is necessary to further insulate the ducts that run through that space as well as any other unconditioned spaces.

The existing water heater was outdated and needed to be replaced with a more efficient option. This project is considered a two-bath home for two to four people and requires a forty to fifty gallon tank or 190,000-btu tankless water heater. The tankless option required an extensive retrofit to the existing piping, so the owners chose to replace the old heater with another forty gallon tank. They installed an Energy Star qualified Apollo gas water heater (see Appendix A, Image 46).

The new efficient furnace comes equipped with an air conditioning unit. Although air conditioner installed is more efficient than most conventional units, the owners do not intend to use it on a regular basis. Michigan has mild summers with average temperature not exceeding 85 degrees. In fact, besides two supplemental ceiling fans located on the second level, the house will depend entirely on a passive cooling system. There are many existing non-mechanical characteristics in the home that help contribute to passive cooling, and some were added during the renovation as well.
Rather than installing an air conditioning system in the house, passive cooling techniques were implemented. The orientation of the house has its longest axis running east and west, therefore maximizing exposure on the south and north elevations. Glazing is enhanced on these facades, which allow more sun to enter the home in the winter, but heat is still controlled in the summer with properly sized overhangs. The location and style of the windows increases air movement inside the house, greatly contributing to cooling. Stagnant air in the home will heat up faster than circulating air. Due to an abundance of operable windows on the elongated facades, excellent cross-ventilation was already present (see Appendix A, Image 47); double-hung windows, however, increased ventilation by allowing warm air to rise and escape through the top of the window while cooler air is drawn in through the lower part of the window (see Appendix A, Image 48). These windows are even more effective when they are greater in height; for example, most of the windows throughout the Coulter-Baker house are nearly six feet in height and are two feet above finish floor.

The east and west facades have very few windows; however, to further block the sun’s exposure, operable shutters are installed on those windows to prevent solar radiation from penetrating the glass and becoming trapped inside. Glass lengthens UV rays preventing them from passing back through once they have entered the home. Exterior shades are the only way to prevent UV rays from entering, interior blinds trap heat between the shade and the glass, slowly heating up the interior of a home. Windows on the south elevation can be shaded with the appropriate sized overhangs. The angle of winter sun and summer sun varies, depending on the location of the home. In addition to structural components, increasing vegetation and reducing heat islands on the site can help shade the house and keep it cool during the summer months.
Any existing appliances in the home at the time it was purchased were over twenty years old and in poor condition, so the owners had to buy all new (see Appendix A, Image 49 & 50), including a stove, refrigerator, dishwasher, clothes washer, and dryer. Any appliance that could carry an Energy Star label was selected from the manufacture list provided on the Energy Star website. The website also provides information and an energy saving calculator in order to determine how much energy each appliance conserves, as shown in Table 10. Any new appliance installed in the home was going to be more efficient than one purchased more than twenty years ago. The stove and oven are not Energy Star qualified appliances; however, the cooktop is a hybrid induction surface that eliminates wasted heat and saves energy by only generating heat when and where the pot touches the surface of the stove. The oven is a convection oven which circulates air inside, allowing it to heat better while using less power.

Table 10

<table>
<thead>
<tr>
<th>Appliances</th>
<th>Manufacture</th>
<th>Energy Star</th>
<th>Estimated Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dishwasher</td>
<td>Electrolux EIDW6105GS</td>
<td>YES</td>
<td>42.00%</td>
</tr>
<tr>
<td>Stove</td>
<td>Electrolux Induction/ EW30CC55GS</td>
<td>NO</td>
<td>0.00%</td>
</tr>
<tr>
<td>Oven</td>
<td>Electrolux/EW27EW55G</td>
<td>NO</td>
<td>0.00%</td>
</tr>
<tr>
<td>Refrigerator</td>
<td>Kenmore # 59432/ 25.1 Cu. Ft.</td>
<td>YES</td>
<td>20.00%</td>
</tr>
<tr>
<td>Clothes Washer</td>
<td>GE WHRE5550KWW/4.1 IEC Cu. Ft.</td>
<td>YES</td>
<td>54.00%</td>
</tr>
<tr>
<td>Dryer</td>
<td>GE DLSR483EGWW/7.0 Cu. Ft.</td>
<td>NO</td>
<td>0.00%</td>
</tr>
</tbody>
</table>

The existing home was equipped with very few ceiling mounted lights; most rooms were lit by lamps and task lighting. The renovation did not include adding many additional
light fixtures, and most lighting that was added was task lighting only. All the rooms in the Coulter-Baker home are under 150 sf, so the owners felt adding decorative lighting or recessed lights was often unnecessary. By recessing a fixture, the delivery of light can be limited; therefore, often times 6 recessed lights will be installed in a room where only one or two task oriented fixtures were needed. Reuse was a main goal for the owners so many light fixtures were found at salvage shops or reused from other projects, including lamps, chandeliers, and wall/ceiling mounted fixtures. All fixtures throughout the entire house were fitted with the appropriate compact fluorescent bulb. By replacing the bulbs alone, the owners will likely save up to fifty dollars on their electrical bill (DTE Energy).

All windows in the home needed to be replaced as part of the renovation. Eliminating old single-pane windows and installing double-pane argon filled windows with low E coatings will help insulate and seal. Almost all existing windows were identical in size, making it easy to order replacements. A professional installer was necessary to help the owners evaluate existing windows and install new, to pick properly insulated windows, and to make sure spray foam and caulk were used for weatherization during the installation. With new windows installed, the owners are likely to see at least a 5% decrease in heating and cooling bills.

A very large part of saving energy in a home has to do with eliminating unwanted air infiltration. The Baker-Coulter renovation involved careful inspection of insulation and wall penetrations to make sure unwanted air was not entering the house. Weather-stripping was added to exterior doors, wall penetrations, and windows. All existing doors in the house required weather-stripping to be replaced; some old doors were reused in new openings and those openings also had to be properly sized and equipped with new weather-stripping (see
Appendix A, Image 51 & 52). The owners made sure proper weatherization methods were used during the installation of the windows, as previously discussed. Weatherization included spray foam used to fill in any gaps between the existing jambs and the new windows. Also exterior caulk was applied to the blind stop and all exterior frame joints. Any exterior wall penetrations in the Coulter-Baker renovation were examined and properly sealed as needed.

Beyond penetrations in the exterior walls, structural gaps and omissions in the construction sequence can lead to energy leaks. The Coulter-Baker house, because of its age, is constructed in a fairly simple manner, excluding excessive architectural massing and ground to roof shafts. There was no existing chimney in the home nor was there a plumbing chase or any other unconditioned spaces hidden behind the walls. The new plumbing chase that was added to accommodate the master bath that penetrates the floor above the crawl space had to be properly insulated. When dealing with a house over a century in age, it can be very difficult to find every leak that exists in the building envelope; however, it is important to thoroughly examine the house in its entirety, fixing as many energy nosebleeds as possible. During the renovation, exterior wall cavities were opened, and it was determined that existing fiberglass (R-13) insulation in the home was replaced over a decade prior to the purchase of the house. Although thirteen is an accepted R-value by Michigan building code, it is does not meet standards set forth by the International Energy Conservation Code. According to the code, developed by the U.S. Department of Energy, in the northern United States walls are recommended to be R-21, floors R-30, ceilings R-49, and basement walls R-13. In an attempt to meet these levels, Coulter-Baker renovation included blowing additional insulation into the walls, ceilings, and floors. The basement walls are a traditional rock wall foundation; therefore, adding any kind of insulation was not feasible. Due to the thickness of
the walls, however, in both the basement and crawl space, insulation is not a concern.

Some energy savings can be accounted for with roofing materials that have a high Solar Reflectance Index. The renovation included replacing all asphalt shingles with metal shingles, greatly reducing the amount of heat absorbed and transferred into the house.

**Finishes and Furniture**

There are an endless number of “green” finishes, furniture, and equipment advertised, and it’s difficult to even know where to begin looking. Because of “green washing,” a concept previously discussed in this study, it is important to thoroughly investigate every green aspect of a product and what it really entails. The primary objective of owners during the Coulter-Baker renovation was to uphold the fundamentals of sustainability such as reducing and reusing. New green technology was also used where applicable but was never to jeopardize the integrity of the historic home. Product and material reuse was incorporated as much as possible because the benefits and embodied energy of reuse proved time and time again to have a greater impact on the environment.

All existing finishes were stripped from the house, including, carpet vinyl flooring and wall covering, lead paint, and any plaster finishes (see Appendix A, Image 53). All doors and hardware were salvaged, all molding was salvaged, and any other materials removed from the home during the renovation had to be evaluated so it could either be reused or properly disposed of. All things that could be recycled, such as drywall, plastics, glass, metal were collected in a separate dumpster and brought to a local recycling center where it was separated by type of material.

The entire floor throughout the house excluding the kitchen and bathrooms was refinished with wood flooring (see Appendix A, Image 54). After evaluating many flooring
alternatives such as bamboo and other rapidly renewable products; the owners decided conventional wood flooring was the best fit for the house. Although wood was chosen over rapidly renewable flooring, the owners made sure all wood came from a certified forestry and was extracted and manufactured within five hundred miles of the home. The species of wood chosen was red oak, a native species to Michigan, and when properly managed can be renewed within 10 years. All stains and sealants used on the floors were non-toxic and low VOC in an effort not to harm indoor air quality. All bathrooms, new and existing, were finished with ceramic tile manufactured by Crossville.

All existing interior walls not involved in any kind of demolition were finished with Sherwin Williams Harmony paint, which contains zero VOC's. New drywall with recycled content was applied to new walls and was finished with zero VOC paint as well. There was no existing lead paint on interior wall partitions. Lead paint was found only on molding and doors, as well as the entire exterior of the home.

All furniture used in the renovation was used or salvaged. Some pieces were purchased at salvage stores; others were reused from previous homes. Most pieces required some kind of refurbishing in order to match them to the interior decor. Low VOC paints and adhesives were used on all refurbished furniture.
The worldwide recognition of the need for environmental change is, without a doubt, one of the most important steps for mankind. However, recognition is only the beginning. Each industry must take action in providing consumers with products and information that will result in lessening our impact on the environment. The green building movement is the extraordinary effort of building professionals everywhere to reduce the impact buildings have on the environment. In his book *The New Ecological Home*, Daniel Chiras describes the effort of these industries as, “Relying on new building principles, practices, and technologies, this bold cadre of green builders is seeking to create shelter while protecting the life-support systems of the planet that sustain people and economies” (Chiras, 2004, p. 5). More importantly, research has proved that it is up to the individual consumers more than anything to integrate sustainable practices into their lifestyles. It is good to have so many industries participating in the green building movement; however, like any new and unregulated market, green advertisement must be regarded with caution because only through thorough research and investigation can the real meaning of green be established.

There is an abundance of previous research, including publications such as *Suburban Nation* (Duany), *Embodied Energy and Historic Preservation* (Jackson), *The Natural House* (Chiras), *Green Remodeling* (Johnston), and countless others, which conclude that the home building industry has a significant obligation to reduce their environmental footprint. Similar to any other area of the environmental movement, the home building industry must sort out what is truly sustainable and what is simply “green washing.” Until then it is up to the homeowner to understand what makes a green home. Such understanding includes
fundamental knowledge of sustainability, background information, and analysis of each new method and material used in a green home or green renovation.

Unlike much previous research, the purpose of this study is to bring awareness toward green renovation to historic homes in particular. This study recognizes the primitively green characteristics of historic homes and their ability to be retrofitted with new green technology. Sustaining historic homes helps maintain the types of homes that are most valuable to the environmental movement. Unfortunately, very little literature exists that focuses primarily on green renovation to historic homes. This study provides the fundamentals and basic background information that is necessary to understand historic homes and their potential in the green building era. This study also provides a better understanding of the value of historic homes by exemplifying a green renovation to a historic home.

Homes have become the focus of many green initiatives, most recognized in the industry in the past couple years is LEED for Homes (USGBC) and REGREEN (USGBC and ASID); beginning with efforts to transform the mainstream homebuilding industry and expanding to recognizing the need to update existing homes with sustainable practices. Modification of existing homes makes up a large portion of the residential building industry and can include homes built as recently as five years ago. Green renovation to these existing homes has become a topic of interest, but not much of these efforts focus on historic homes. Again, “historic” means homes nearly a century old that were built before the exploitation of mass production and that possess certain historical significance.

This study provides the background information necessary to understand how some historic characteristics can make historic homes primitively green. As previously discussed, primitively green homes are homes that made a positive contribution to the environment even
before new green materials and technology are applied while items such as connectivity, site selection, water conservation, energy efficiency, and material selection are all a part of the focus on greening homes. However, historic homes most often portray more fundamental approaches to sustainability, including

- protecting historical significance of a community;
- Alleviating new construction and suburban sprawl; and
- harvesting of embodied energy.

In protecting the historical significance of a home, one must maintain certain characteristics that will help sustain the home and are rarely present in new construction. Such items include

- architectural detail;
- individuality or character;
- contribution to community and sense of place;
- quality craftsmanship;
- appropriate size and proportion;
- integration with surroundings; and
- salvageable or reusable materials.

The kind of value these items can bring to a home will not only make for a more interesting living space but can also contribute more to the environment than most newer homes. Often, people think of older homes as out dated and therefore likely not in tune with the modern green building movement. Knowing the fundamental concepts of sustainability and the background behind the significance of historic homes will help people understand the importance of renovating them and maintaining their unique qualities.
Understanding the historical significance involved in sustaining historic homes is just the first step. Knowing the basics behind new green technology and materials is also very important when renovating a historic home. The primitively green characteristics, discussed previously, are just the reasoning behind a renovation to a historic home; methods and materials used in the renovation process will make a further contribution to environment.

The term “green” is used as a marketing tool in the residential industry and is applied to many features of new homes. Because green is commonly associated with new products and technology, it is important to prove that old homes can be successfully retrofitted with the same green methods and materials as the new ones. The purpose of this study is to bring awareness to historic homes and to outline how the same green aspects that could be present in a new home can also be applied to a historic home. The overview of what's involved in a green retrofit is broken down into categories that are found in current literature and other green initiatives, categories such as

- design and layout;
- a low impact site;
- water efficiency;
- building envelope and energy efficiency; and
- finishes and furniture

These areas of focus are intended to provide the best comparison of how a green retrofit to a historic home can be compared with new green homes. In-depth research established the most feasible methodology for greening homes and outlined which approach, in each area of focus, could be applied to a historic home. The methodology section of this study was successful in establishing different aspects of a green retrofit when dealing with a historic
home, ones that would be successful and ones that would have drawbacks. Every home or project is unique, so it was necessary to provide a case study in order to show how the methods being described would be incorporated in a specific instance.

The case study chosen was an accurate example of a historic home that would most likely be found in the United States. This particular house, the Coulter-Baker Homestead, fits the definition set forth by *The National Register of Historic Places* which describes historic homes as those “..that possess integrity of location, design, setting, materials, workmanship, feeling, and association” ([http://www.nps.gov/nr/listing.htm](http://www.nps.gov/nr/listing.htm)). An overview was given on the house describing how it has retained such historical integrity and can be characterized as a primitively green home, which makes it a perfect candidate for a case study.

The case study successfully depicted a home with a certain amount of innate sustainability that was discussed in the significance of the study. A chosen series of strategies, from each area of focus established in the study, was adequately demonstrated by this particular green retrofit project. Design and layout was addressed by updating the floor plan to accommodate a modern lifestyle, while still retaining the essence of the original space and preserving architectural features and historic detail. Site changes included reducing/altering hardscapes to minimize heat island effect and runoff, incorporating native plantings and limiting turf grass, and adding a rain garden and a rainwater catch system. Indoor water efficiency was increased by installing water-saving plumbing fixtures. Energy efficiency was addressed by installing energy efficient equipment, enhancing the passive cooling system, installing efficient appliances, and properly sealing and insulating the building shell. Furniture and finishes were incorporated into the green renovation by reusing and refurbishing as much as possible and purchasing new recycled, renewable, or low-impact
This case study depicts how one historic house can be transformed into an up-to-date, environmentally conscious home and is not designed to give extensive detail on every available green material or methodology. Although the case study provides insight to areas of inefficiency that could be encountered during retrofit, it was not able to provide specific data on the amount of water and energy conserved due to the home owner's lack of information on the amount of consumption prior to their purchase of the home. All energy and water savings established in the renovation are in comparison with standard conventional usage. The strategies demonstrated in the case study successfully give insight to how a green retrofit to a historic home would be achieved and draws attention to their potential in sustaining the environment, a potential that not much previous literature has even acknowledged.

One home cannot represent the millions of different historic homes around the country, however, this project was chosen as a case study to represent the significant number of nineteenth century, wood frame homes built in small and large communities throughout the country; Historic homes exist in drastically different climates and have a much different integrity of location, design and craftsmanship; nonetheless they are all worthy of green renovation and will require different strategies than those which are described in this case study. Furthermore, existing homes may adhere to the strategies previously discussed but may lack the historical significance that is so predominant in this study.

As the green building movement becomes more mainstream, there is an abundance of information on different green materials and methods, and there are several green initiatives that focus on commercial buildings, schools, homes, hospitals, and so on. The technology that is impacting the environment is groundbreaking, and a lot of attention is given to how to
apply it to the building industry. It is important, however, to not lose sight of the importance of reducing construction, even if it is being carried out in a much more efficient manner.

While this study could help to increase recognition of historic homes in the sustainable building movement, there is much to be desired in the amount of publication on the issue. Like any type of change, global recognition of alleviating new construction will take time. In the meantime an increase in literature written on the topic of preservation and embodied energy is needed to help people understand the role of historic buildings in the green building era. Initiatives set forth by the design and building industry could help to increase preservation and building reuse. However, a widespread understanding that reaches out to the general public is going to be most successful when it comes to green renovation.

Even the most aggressive environmental codes cannot save the environment if the amount of construction continues at the same rate as it has in the last fifty years. Reusing homes and harvesting embodied energy is arguably the most important green initiative. Historic homes go beyond the simple act of reuse; they preserve sustainable qualities that were imperative to life over one hundred years ago and can be hard to find in modern neighborhoods.
References


Kyvig, D. E. (2000). *Nearby history exploring the past around you*. Walnut Creek, CA: AltaMira


<http://www.nps.gov/nr/national_register_fundamentals.htm >.


APPENDIX A
Images
Frank Lloyd Wright’s Usonian architecture was designed with human scale proportions and comfortable spaces for people to carry out their daily lives.

Sublime architecture has infiltrated the homebuilding industry; homes today are designed to impress visitors rather than create comfortable living spaces.
Image 3: Low-impact development is a new trend emerging in the U.S. which considers density, walkability, proper vegetation and proper amount of pervious surfaces.

Image 4: Neighborhoods built over a century ago, before the industrial revolution, valued high density building and walkability, a concept that is becoming prevalent again in the twenty-first century.
Image 5: A disdain for the nation’s historical landmarks would outrage the American people; yet it is acceptable on a smaller scale (top: Quincy Market, Middle: Bourbon Street, Bottom: Williamsburg).
Image 6: A community must have a special quality and character that helps develop personal and cultural connections for surrounding neighborhoods. The generic commercial strips that separate suburban neighborhoods offer very little to appreciate.
Image 7: Suburban developments are often repetitive, unmindful of their surroundings, and constructed with cheap and insufficient methods.

Image 8: Suburban developments often claim access to shopping, restaurants, office parks, and so on. In reality, they simply lie adjacent to these amenities with roadways, gates, walls, and landscape berms separating any real connection to them.
Image 9: A house cannot be defined by its size. Massive living spaces will leave people in a constant quest for comfort within their own home.

Image 10: Homes like this one pictured can be found in a typical upper-middle class suburban development in the U.S., contributing to the most lavish and excessive housing in the world.
Image 11: A historic home being brought to the ground.

Image 12: Not only is the significance of historic places completely disregarded during a demolition valuable but also materials are lost in a “bulldozer blitz.”
Image 13: Small single-use spaces can be transformed into one multifunctional space.

Image 14: Smaller intimate task-oriented areas in a multi-functional room can help to create a comfortable living spaces.
Image 17: A driveway is one of the worst offenders for stormwater runoff; replacing it with pervious materials can make a large contribution to creating a sustainable yard.

Image 18: Incorporating native plantings throughout a site is one of the most important sustaining features on a site.
Image 19: A simple rainwater collection system can feed into an irrigation system and can be incorporated on most small sites.

Image 20: Forced air furnaces can be found in most homes.
Image 21: A Heat pump is similar to a forced air system but uses freon gas to absorb heat from the outside air and transfers it inside.

Image 22: A boiler is somewhat unique from other systems in that it uses hydronic delivery to heat a home through radiators.
Image 23: Historic homes often have porches and large overhangs that can help significantly. They stop the sun from entering a house. (top) Adding canopies, pergolas (bottom), shutters to the exterior can also help.

Image 24: Blocking solar radiation from the exterior is most important in order to keep it from penetrating glass surfaces.
Sealing or caulking window jambs will help to seal the building envelope and limit air infiltration.

Whether repairing or replacing old windows, it is important to preserve decorative or ornate moldings in order to maintain historical integrity.
Image 27: These images indicate areas of concern that require proper insulation.

- Use foam board and canned, or spray, foam to seal the framing.
- A better way to build soffits is to drywall the ceilings and walls before framing the soffit.
- This dropped soffit connects the walls to the ceiling, making a path for air leakage.
- Use or cementboard to bridge the framing and the chimney, with a fire-rated sealant.
- Where cold air is supposed to go...
- Solid blocking can stop cold air... Where cold air really goes
- Kneewall
The North Milford Village Historic District consists of approximately 140 acres and includes the historic commercial area along three blocks of North Main Street. Residential areas are along five east-west streets and six north-south streets.


Image 29: The North Milford Village Historic District consists of approximately 140 acres and includes the historic commercial area along three blocks of North Main Street. Residential areas are along five east-west streets and six north-south streets.
Image 30: Milford’s beginnings included the Saw Mill that was the first building erected in the village (top), the Milford Post office (middle), and looking down Main St. (bottom)
Image 31: Milford has preserved its historic buildings for nearly two centuries.

Image 32: As much material as possible was salvaged and reused during the renovation.
Image 33: Existing Floor Plan (dashed lines indicate demolition)
Figure 4.2 - The Baker-Coulter homestead (bottom) compared to another late 19th century Victorian home (top)

Image 34: New Floor Plan with interior finishes and square footage

1st Floor
- Toilet - 20sf
- Kitchen - 120sf
- Dining - 120sf
- Multi-Purpose Rm - 128sf
- Living Room - 169sf
- Den - 100sf

2nd Floor
- Master Bedroom - 170sf
- Master Bath - 30sf
- Extra Bedroom - 195sf
- Bath - 48sf

TOTAL USEABLE: 1,100sf
TOTAL: 1,449sf
Image 35: Unlike the old enclosed stairway (below) the new one (left) provides interaction between the first and second floor and makes the space seem larger.

Image 36: Transforming an underused porch into an all-weather room creates a unique room and adds more useful space to the house.
Image 37: A new master bath was added on to one existing bedroom upstairs to make a master suite.

Image 38: Existing site plan.
Image 39: Below is an image of an area map of a half mile radius around the Coulter-Baker house, showing some of the local amenities.

Image 40: Below is the design of the residential rain garden used in Coulter-Baker site renovation.
Image 41: Simple residential rain barrel catch water system for landscape irrigation used in Baker-Coulter renovation.

Image 42: Metal shingle roof replaced all asphalt shingles on the house and garage.
Image 43: New Site Plan for Coulter-Baker renovation, with Native Plant Key.
Image 44: New Energy Star Lennox air handling unit with sealed access panel was installed.

Image 45: Sealing connections between ducts can help increase air-tightness.
Image 46: An EnergyStar water heater was installed during as a part of the retrofit.
Air warms and rises, cooler air enters. Hot air exits cooler air enters.

Image 47: To the left is a floor plan showing cross ventilation patterns from numerous windows throughout the house.

Image 48: The image to the left demonstrates how cooler air will enter low, warming as it travels through the interior space and then will exit at a higher point, thus making double hung windows more feasible for passive cooling.
Image 49: The existing, outdated kitchen, photographed before the renovation started.

Image 50: All kitchen appliances were replaced with energy efficient equipment.
Image 51: Antique doors were salvaged and used in the renovation due to the amount of historical character they brought to the home.

Image 52: Weather stripping was added to all new and existing door openings, and frames were refurbished sealing any gaps or cracks in the frame.
All existing finishes were stripped from the house.
Several new environmentally friendly interior finishes were added during the renovation, including low VOC paint, salvaged furniture, and certified wood flooring (pictured below).
APPENDIX B
Architectural Drawings
1st Floor
Toilet - 20sf
Kitchen - 120sf
Dining - 120 sf
Mult-Purpose Rm - 128sf
Living Room - 169sf
Den - 100sf

TOTAL USEABLE: 1,100sf
TOTAL: 1,449sf

2nd Floor
Master Bedroom - 170sf
Master Bath - 30sf
Extra Bedroom - 195sf
Bath - 48sf

TOTAL USEABLE: 1,100sf
TOTAL: 1,449sf

Coulter-Baker Homestead
234 1st Street
Milford, Mi 48381

New Floor Plan
Scale: 1 /4" = 1'-0"
APPENDIX C
Photographs of Coulter-Baker Renovation