# GREENING THE TOWN CENTERS OF AMERICA: AN INVESTIGATION INTO THE SUSTAINABILITY OF BUILDING REUSE IN RELATION TO THE ECONOMY AND ENVIRONMENT

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# GREENING THE TOWN CENTERS OF AMERICA: AN INVESTIGATION INTO THE SUSTAINABILITY OF BUILDING REUSE IN RELATION TO THE ECONOMY AND ENVIRONMENT

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## ABSTRACT

Our society promotes the 3 R's of conservation (Reduce, Reuse, Recycle) as a solution to our personal waste, however it is not a strategy commonly applied to our building stock. Sustainable design is regarded as the solution to environmental troubles that we face today nationally as well as worldwide. High performance buildings featuring energy efficient technology are deemed the most economically and environmentally sustainable option. This paper is an investigation into the economic and environmental viability of building reuse and retrofit (in downtown American cities) in comparison to demolition and new construction of a 'green' building. This thesis is a meta-analysis of existing research and case studies to investigate the benefits of green building in relation to the definition of sustainability and explores the obstacles to further progress.

# CHAPTER I

# INTRODUCTION

The oil embargo in 1970's instigated a trend in energy conservation that has increased over the past 40 years (Smith, and Elefante, 19). The noticeable increase in greenhouse gas emissions that contribute to global warming, most importantly carbon dioxide (CO2), has led to a reassessment of our day-to-day activities and how they affect our ecological system. Human activities such as deforestation and burning fossil fuels for energy have resulted with intense environmental damage (Khasreen, Banfill, and Menzies, 675). The U.S. Department of Energy (DOE) released statistics that indicate buildings as the greatest GHG sources, "producing more than 700 million metric tons of carbon dioxide or its equivalent annually." (Smith, and Elefante 23). Our built environment accounts for about 40% of all energy consumption in the United States alone, and 33% worldwide. "The construction, characteristics, operation, and demolition of buildings are increasingly recognized as a major source of environmental impact" (Fischer, 1). Slowing the growth of energy-related greenhouse gas emissions from our nation's buildings has become a major topic of concern for environmental proponents. "Making buildings more energy efficient is one of the most immediate and measurable ways to address this growing concern" of the degradation of the environment (Campagna, and Frey, 22).

Sustainable Development and the Built Environment

"Americans are placing more and more demands on buildings—particularly to conserve energy, reduce environmental impact, and improve safety and security" ("High Performance Building Council", 2011). Modern building design has become increasingly more focused in sustainability, mainly to maximize both economic and environmental performance of buildings (EPA, 2012 a). But what is sustainable development, per say? There have been multiple ideas of what true sustainability is, but the most widely accepted was introduced by the U.N. Bruntland Commission report *Our Common Future* in 1987. In this report, sustainable development was defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". When sustainable development is applied to the built environment, more attention is placed on the energy efficiency of the building rather than the sum of various components. A newly constructed building that includes the deliberate consideration and integration of many attributes, mainly energy efficient technology, is known as a high performance building ("High Performance Building Council", 2011). This terminology was introduced by the Energy Independence and Security Act of 2007, specifically defined, a high performance building is a "building that integrates and optimizes on a life-cycle basis all major high performance attributes, including energy conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality and operational considerations" ("High Performance Building Council", 2011). There are many benefits to high performance, or green building, such as: 30% energy savings, 35% carbon savings, 30-50% water savings, and 50-90% waste cost savings (Campagna, and Frey, 22).

The majority of the savings are mutually beneficial to the environment as well as the economy. The only issue that brings to question the true benefits of high performance design is when an existing building is demolished and replaced with new construction. This is not an unusual occurrence; roughly 1 billion square feet of buildings are demolished and exchanged for new construction in the United States on an annual basis (Nelson, 13). The Brookings Institution projects that roughly one-quarter of today's existing building stock will be demolished and replaced between 2005 and 2030.

Purpose of this Paper:

America has an obsession with new ‘green’ technology, and there is fallacy that a building has to be new to integrate it in the design. However, a building doesn’t have to be new to be considered ‘green’. An existing building “can undergo a top-to-bottom green renovation that incorporates green design, building products, and technologies” ("The Dollars and Sense of Green Retrofits", 1). True sustainable development calls for the consideration of the larger context of the built environment. “Reinvestment in existing, more sustainable neighborhoods – especially our older and historic ones – saves resources and promotes socially, culturally, and economically rich communities” (Pocantico Proclamation, 2009). Building reuse and green building communities share a common goal: securing a viable, sustainable, meaningful future for our children and the generations that follow them (Campagna, and Frey, 31). High performance buildings are rumored to be more economically efficient and environmentally sustainable than building reuse. However, reusing an existing building, especially one that takes advantage of the existing infrastructure in town centers, seems to be a viable option in comparison with a newly constructed high performance building. Through case studies and research, I will explore whether or not building reuse can be as sustainable for the environment as well as more economical demolition and construction of a green building.

Scope and Definitions:

There are multitudes of building types, categories, and possible locations. For the purpose of this paper, I will focus on commercial buildings located in town centers. I will refer to many of the existing buildings as 'historic', meaning that they are over fifty years old and not that they reside on the national register. Most existing buildings that are at risk for demolition located in downtowns meet this criterion, because they do not have the ability to rely on the protection the National Register provides through rules and regulations.

# CHAPTER II:

# A QUALITATIVE EXPLORATION OF BUILDING REUSE

This chapter will explore the qualitative and environmental benefits of building retrofit and reuse over the entire lifecycle of a building. The common misconception of historic buildings is that they are energy sieves. This argument prompts developers to justify tearing down a building to build a high performance structure, for the main purpose of energy efficiency in the operation of the building. However, this stance undervalues the rest of the energy that flows through the entire lifecycle of the building. Repurposing and retrofitting old buildings reduces the consumption of land, energy, and materials required for new construction by capitalizing on the existing resources provided in each stage of life in the building (EPA, 2012 b). Operation is just one stage of a building's life, each building consumes energy during its life cycle in stages, such as raw material extraction, transport, manufacture, assembly, installation as well as its disassembly, demolition and disposal" (Culp et al., 3731). Buildings are constructed with a variety of building materials, each of which consumes energy throughout its stages of manufacture, use, and deconstruction. Most environment-benefit studies promoting new construction focus mainly on operating efficiency improvements, overlooking the option of renovating an existing building to improve its operation efficiency. "New mechanical equipment is just as efficient in an old building as it is in a new building" (Jackson, 51). The cost of manufacture and installation, known as initial cost, is typically held in higher consideration in order to find the lowest-cost option (Cluver, and Randall, 6). Assessment of the energy in buildings should be performed keeping a life cycle perspective, in order to adequately compare building reuse to demolition and construction including energy and material inputs during all of the stages of the buildings life (Culp et al., 3732).

Embodied Energy, the Beginning of a Building's Life:

Energy invested during construction does not go to waste with the continued use of a building. The energy expended in the first stage of a buildings life cycle is known as embodied energy. "Embodied energy is the sum of all the energy required to extract, process, deliver, and install the materials needed to construct a building. Embodied energy has received some attention in the green-design community but not nearly as much as operating-energy reduction" (Jackson, 47). Embodied energy should be a major point of comparison because it cannot be regained once spent on a building (Frey, 2008, 9). The energy embedded in the initial construction can be significant in comparison to the other stages of a building's life cycle, and can have many adverse impacts on the environment ("Sustainable Historic Preservation", 2010). The extraction of natural resources for construction purposes and the production of building goods are energy-intensive processes that release significant CO2 emissions, among other negative impacts such as the following (Renovating vs. Building New: the Environmental Merits, 3):

- Fossil fuel depletion
- Other non-renewable resource use
- Water use
- Global warming potential (Carbon Dioxide emissions)
- Stratospheric ozone depletion and ground-level ozone creation
- Nitrification/eutrophication of water bodies
- Acidification and acid deposition (dry and wet)
- Toxic releases to air, water, and land

These impacts adversely affect our ecological system, creating situations we have never encountered before, such as global warming, decrease in potable water, and pollution. All these side effects of extracting material can be decreased with building reuse, especially with historic buildings because of their relatively high embodied energy (Jackson, 50). With regard to the definition of sustainability, the energy used to manufacture building parts is saved for future generations and the demand for new materials is reduced with the recycling of existing buildings (Smith, and Elefante 20). Additionally, “More long-term energy savings can be gained by improving the operational efficiency by 10% than by reducing the embodied energy by a similar amount. However, when the embodied energy is recaptured through building renovation, the equation is greatly altered” (Jackson, 51).

Demolition, the End of Building's Life:

Construction waste is becoming a serious environmental problem in many large cities across the United States. As mentioned before, building demolition creates approximately 1 billion square feet of waste annually. Demolition debris specifically for commercial buildings produces about 155lbs of waste per square foot. The EPA stated that "136 million tons of building-related construction and demolition (C & D) debris was generated in the United States in 1996. By 2003, C& D waste was estimated to be 325 million tons – almost a 250% increase in just seven years" (Frey, 2007, 10). Construction and demolition waste can include things like hazardous waste, concrete waste, solid waste, and sanitary waste of which can contaminate soil (Ooshaksaraie, Leila, and Alireza Mardookhpour, 496). The makeup of the discarded demolition waste can include chemicals such as cyanide, iron, antimony, manganese, magnesium, sodium, lead, and mercury. The disposal of these harmful chemicals into landfills has led to contamination of ground water and surface water (EPA, 1995). The only way to decrease the amount of waste deposited would be to reuse and reinvest in our existing building stock instead of demolishing it and building new.

Life Cycle Assessment:

As stated above, there are more components that contribute to the sustainability of a building than just energy efficiency in operations. The first and last stage are the two stages that are commonly overlooked when considering building reuse versus new construction (Cluver, and Randall, 9). Operational energy constitutes a larger proportion of a building's lifecycle energy when compared to embodied energy. "However, recent research has emphasized the significance of embodied energy and has acknowledged its relative proportion of total energy, which is growing with the emergence of more energy efficient buildings" (Culp et al., 3731). As a building's operating energy percentage gets smaller, the percentage and importance of the building's embodied energy grows. One tool that can be used to compare the overall life benefits of reuse and retrofit versus demolition and new construction is called Life Cycle Assessment (LCA). "The assessment includes the entire life-cycle of a product, process, or system encompassing the extraction and processing of raw materials; manufacturing, transportation and distribution; use, reuse, maintenance, recycling and final disposal" (Khasreen, Banfill, and Menzies 676). LCA is very data intensive, and requires robust data in order to calculate embodied energy for each building as well as operations and demolition (Culp et al., 3732). LCA is a strategy used to measure environmental performance of a building over its entire life cycle, many times referred to as a cradle-to-grave analysis. The main goal of completing an LCA is to analyze all relevant effects associated with a building over its entire life cycle (Trusty, 3). When LCA is uses a holistic approach to building consideration. LCA is the promoted method in order to achieve true sustainable construction (Syal et al., 16). LCA is very advantageous when comparing environmental costs of rehabilitation and new construction, it enables an in-depth analysis of how key variables such as life span and operating energy efficiency may affect the decision. Most findings are favorable for building reuse (Frey, 2007, 9).

Preservation Green Lab Report:

The Preservation Green Lab, a field office of the National Trust for Historic Preservation, completed a study that exemplifies the advantages of using LCA as a strategy for building reuse. The Preservation Green Lab was originally launched in March 2009 with the specific goal to advance research that explores the qualitative value of older buildings and pioneers solutions to make it easier to reuse and retrofit historic buildings ("Preservation Green Lab", 2012). Their report, "The Greenest Building: Quantifying the Environmental Value of Building Reuse" was created to explore LCA as an adequate way to compare the environmental benefits of reuse and retrofit versus new construction of a high performance building. The study examined many different building types over a projected 75-year life span. For the purpose of this paper, I will only survey their results for the Urban Village Mixed-Use building type (these are the classic downtown buildings located in the core area of cities). The scope included four environmental impact categories, including climate change, human health, ecosystem quality, and resource depletion. The buildings examined were located across four U.S. cities, each representing a different climate zone, i.e., Portland, Phoenix, Chicago, and Atlanta. They found that when these buildings were retrofitted to perform at the same efficiency levels as new construction, reusing buildings is more environmentally responsible than building new. A newly constructed building, projected to be 30% more efficient in operations, was found to take between 42 to 80 years (depending on region) to justify the negative climate change impacts related to the embodied energy wasted in demolition. This study, producing the report "The Greenest Building: Quantifying the

Environmental Value of Building Reuse", was very successful in proving the environmental benefits intrinsic in building reuse, when the existing building was retrofitted to be more energy efficient.

Sprawl, New Urbanism, and the Environment:

A main attraction about historic downtown buildings is the lifestyle they promote. Older downtowns represent the cultural and social core of the city that they serve (Frey, 2008, 4). “Cultural heritage can also be a strong building blocks for revitalization, improvement, smart growth, and sustainability” (Facca, and Aldrich 40). Taking a walk through a revitalized downtown can connect us to the past and provide a sense of place to present and future generations. A large part of sustainability revolves around cultural and social aspects that town centers cultivate. “A dynamic form of collective memory, history is a record of time and human experience. Closely related to the arts, humanities, and cultural heritage, it is physically and visually expressed in a community’s buildings, sites, structures, objects, and landscapes” (Facca, and Aldrich 40). Any city can duplicate another’s water lines, or industrial park, but duplicating another city’s cultural heritage is close to impossible. Cultural heritage is the fingerprint of a community, unique to each one.

In addition to preserving culture, building reuse and retrofit in town centers maximizes the use of existing infrastructure and materials (“Sustainable Historic Preservation”, 2010). Retrofitting and reuse promote “efficient land use patterns that focus on that focus public and private infrastructure investments in established urban areas where substantial past investments have already been made” (Frey, 2007, 10). These past investments extend beyond building walls, energy preserved can also include existing infrastructure such as roads, water systems, and sewer lines. Reinvesting in the town center offers a way to capitalize on the energy in one single building, but on the infrastructure that serves buildings.

True sustainable development requires taking a step outside a building and designing with relation to its surroundings. Buildings are integral parts of urban places the same way that windows, doors and columns are integral parts of buildings. Sustainable development is concerned with a building's ability to fit into their local and regional surroundings and form distinct places (Kelbaugh, 165). However, the mass exodus of people from the city core to suburbs since the 1950's has caused a notable problem. Everyone wants a piece of the so-called 'American dream', but "the media and the professional planners have long had another name for it. They call it sprawl" (Mitchell, 2001). This movement of people from more sustainably designed places to far less sustainably developed areas creates an uncertain future for fossil fuels (Frey, 2008, 19). In 1950, seventy million Americans lived in the nation's urbanized areas, covering some 13,000 square miles. "By 1990 the urban-suburban population had more than doubled, yet the area occupied by that population almost quintupled—to more than 60,000 square miles" (Mitchell, 2001). The large proportion of the population that resides in suburban areas featuring little connectivity to places nearby, requires the extensive use of cars. As more people exit the city boundaries, the amount of time spent in stressful traffic will increase.

One strategy to combat urban sprawl that has begun to take hold over the sustainable development sector is known as 'New Urbanism'. The asserted goal of New Urbanism is to reduce the environmental impact of development and protect natural areas. One outlet to achieve this goal is "to cut land consumption through more compact development; decrease air pollution and energy consumption by reducing driving; and limit water pollution by preserving wetlands and by reducing the number of roads and other impervious surfaces that produce contaminated runoff' (Pollard, 11). New Urbanism draws many planning techniques from historic town development, which infers the conclusion that 'New' Urbanism is in fact 'Old' Urbanism.

Historic town centers are usually "built more compactly out of necessity, and tend to be dense, walkable, feature mixed uses, and are very often accessible to public transit" (Campagna, and Frey 28). When areas are walkable and mass-transit accessible, they decrease dependence on cars thus decreasing dependence on fossil fuels and the pollution that results. Compact, dense building reduces the impact of development on water quality and water resources by preserving natural drainage and other landscape features that decrease pollution due to runoff (Pollard, 13). Preserving the open space and long-term thinking by investing time and resources in restoring dense, existing infrastructure revitalizes the surrounding community (Campagna, and Frey 26). New Urbanism can often incorporate building retrofit and reuse, and many times this is the optimum solution for the sustainable development of a city.

Discussion of Environmental Benefits:

The analysis of the gathered research and case study report uncover the environmental value of reinvesting in our existing building stock. Building reuse capitalizes on the energy already deposited in the building, reducing (and preventing) potential and existing damage to the environment. It promotes a culture of reuse through maximizing the use of existing materials and infrastructure ("Sustainable Historic Preservation", 2010). Research has shown that obtaining environment-related product information by LCA is an important step of design. "All assessments of environmental performance of products must include evaluation based on examination of a broad range of environmental indicators representing the full life cycle of products using internationally accepted protocols for evaluation" (Bowyer, 16). LCA must play a major role in evaluation and labeling of a building's benefit to the surrounding environment. Retrofit and reuse of buildings stimulates a more sustainable lifestyle among the constituents of the city, through their relation to the town center. "A historic building or district can be a tangible symbol of a community's interest in honoring its heritage, valuing its character and sense of place, getting the most out of prior investments in infrastructure and development, and encouraging growth in already-developed areas" (EPA, 2012). The combination of information concludes that retrofitting and reusing a building is environmentally more sustainable than replacement with a newly constructed high performance building.

# CHAPTER III:

# BARRIERS TO BUILDING RETROFIT AND REUSE

The previous chapter explains with research that there are more qualitative, environmental benefits associated with building reuse and retrofit compared to demolition and construction of high performance buildings in town centers. If building retrofit and reuse is the environmentally sustainable solution, then why are buildings demolished and replaced with new construction? This chapter explores the answer to this question, taking a closer look at the arguments and obstructions to building reuse.

Economy is King:

"Qualitative expressions of the value of preservation often are dismissed by economists simply because they are not susceptible to standard economic (mathematically driven) methods of analysis" (Mason, 3). Quality of life is subjective, even with objective measurable proxies for aspects of it (Levett, 297). Our society validates construction benefits based on the economy, and the importance environmental benefit fall short in comparison. There are many market distortions that need to be addressed before any consequential change can occur. "While it may seem intuitively obvious that retaining and renovating older buildings has environmental merit, the case is difficult to prove without access to the appropriate data and tools. It is especially difficult to convince developers, when the monetary costs of major renovations often exceed the cost of building new" (Frey, 2008, 1). The conventional way of evaluating the economic benefits is by mainly considering capitol and energy costs of a building, as there hasn't been an extensive environmental cost/benefit analysis completed for a viable defense for building reuse. Additionally, decisions about building-related investments typically involve a great deal of uncertainty about their costs and potential savings. Renovating costs can be uncertain because of the unknowns inherent in the process. "Many developers fear being surprised by the unforeseen challenges once rehabilitation is underway", and thus they often cannot economically justify retaining the existing buildings (Preservation Green Lab, 2011).

Discouragement of LEED:

Building codes and rating systems often inadvertently undermine efforts to reuse existing buildings, historically favoring needs and goals of new construction (Preservation Green Lab, 2011). A specific rating system that seems to undervalue building reuse is the Leadership in Energy and Environmental Design (LEED) rating system, developed by the United States Green Building Council (USGBC). LEED uses a framework point system where points are disbursed based upon certain environmental criteria met in the design of the building. A building could become LEED certified with a certain amount of credits, and depending upon that amount it could be labeled as "silver", "gold", or "platinum" (USGBC, 2012). "LEED provides building owners and operators a concise framework for identifying and implementing practical and measurable green building design, construction, operations and maintenance solutions" (Tess 1). In the building industry, LEED certification is regarded with respect and used as recognition of social responsibility and leadership. Even state and local governments, "and some federal agencies, such as the General Services Administration, now recommend or require that construction projects earn a LEED rating" (Campagna, and Frey 22). However, LEED has been criticized for the failure to take into account the value of continued reuse and greening of existing buildings because of the overwhelming focus on new construction. In all the points available for consideration, there is a lack of accounting for a building's historic or cultural value (ASLA, 2011). Additionally, the LEED system has been criticized "for not taking a scientific and life-cycle perspective in assessing environmental impacts and in the evaluation of alternative designs and practices" (Syal et al., 15). In the distribution of points throughout the system, LEED does not provide a consistent structure for the achievement of environmental goals from a life-cycle perspective. “To quantify the benefits of keeping materials within buildings, a lifecycle cost analysis (LCA) needs to be done holisticallybacross the entire process” (ASLA, 2011).

In the recent release of LEED 2009, the USGBC argue that they revamped the LEED system to include promotion of existing building retrofit. However, the changes address some, not all, of the concerns (Campagna, and Frey 22). To confirm this, I went directly to the source, “LEED 2009 For New Construction and Major Renovation”. The categories of point distribution are:

- Sustainable Sites (26 possible points)
- Water Efficiency (10 possible points)
- Energy and Atmosphere (35 possible points)
- Materials and Resources (14 possible points)
- Indoor Environmental Quality (15 possible points)
- Innovation in Design (6 possible points – bonus)
- Regional Priority (4 possible points – bonus)

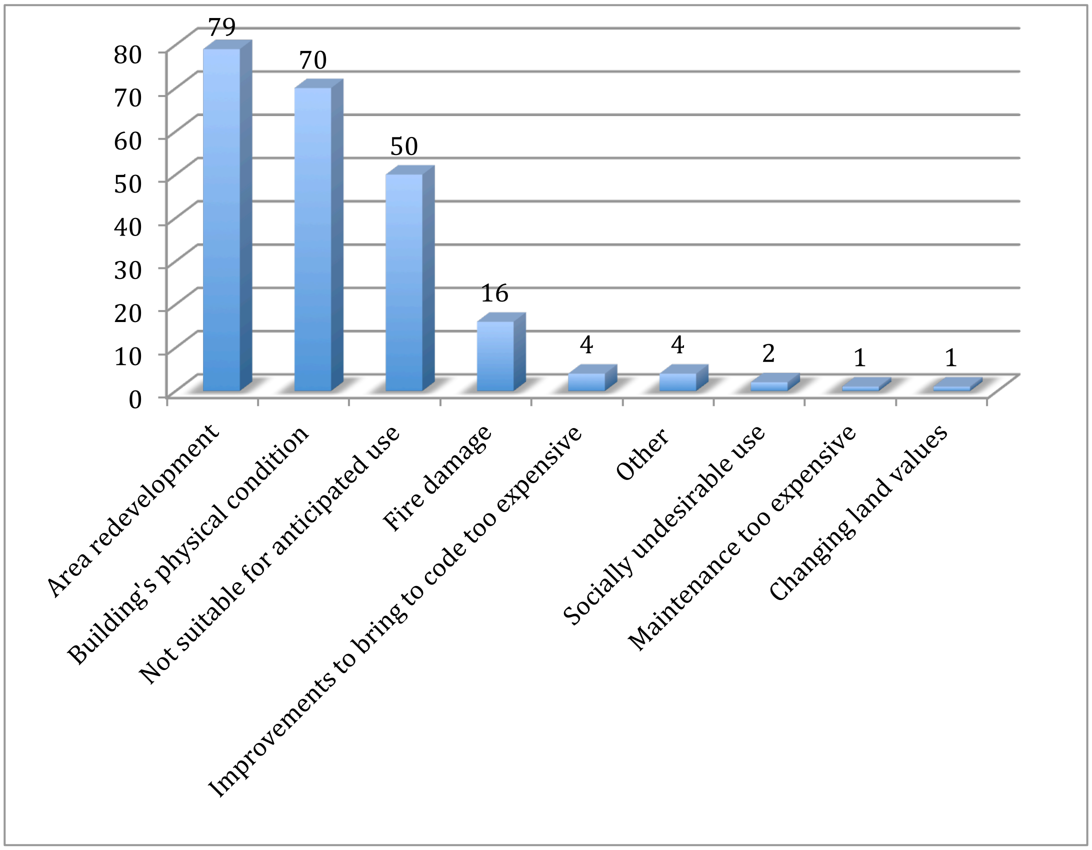
The areas that include mention of the reuse of existing buildings are ‘Sustainable Sites’, and ‘Materials and Resources’. Under Sustainable sites, credit 2 (Development Density and Community Connectivity) is worth a total of 5 points. The intent of this section is “to channel development to urban areas with existing infrastructure, protect greenfields, and preserve habitat and natural resources” (USGBC, 2009, 3). Under Materials and Resources, credit 1.1 (Building Reuse – Maintaining Existing Walls, Floors and Roof) Is worth 1-3 points. The intent of this section is “to extend the lifecycle of existing building stock, conserve resources, retain cultural resources, reduce waste and reduce environmental impacts of new buildings as they relate to materials manufacturing and transport’” (USGBC, 2009, 48). These two sections that specifically address building reuse are only worth a maximum of 8 points out of a total 110 possible. In comparison, the Energy and Atmosphere section is worth a total of 35 points with 19 points possible exclusively in credit 1 (Optimize Energy Performance). This section’s intent is “achieve increasing levels of energy performance beyond the prerequisite standard to reduce environmental and economic impacts associated with excessive energy use” (USGBC, 2009, 35). According to LEED, a developer could get 19 points for integrating energy efficient technology, but only 3 points for reusing 95% of a building. Less than 10% of the overall points are attributed to encourage building reuse, allowing a building to be certified to any level without even considering reuse. It seems clear that the LEED system is more of a proponent for optimizing energy efficiency in operations rather than capitalizing on the energy embodied in an existing building. However, “the reused embodied energy of the components could easily be 50% of the building's total embodied energy. If one compares the benefit of reusing a building versus the construction of an entirely new building, the embodied is even greater” (Jackson, 50).

In a way, the influence of green building programs is positive by “causing builders, architects, home buyers, and others to think systematically about how to improve the environmental performance of buildings. A negative aspect is that directors of the best-known programs have fallen victim to adoption of prescriptive standards for environmentally preferable materials that are based on intuitive judgment and/or single attributes" (Bowyer, 14). The LEED system has serious drawbacks with the lack of accurately distinguishing low environmental impact activities from high impact activities. By reputation, LEED is a 'green' building program, but because it encourages use of energy efficient technology over building reuse, it is 'green' in name only (Bowyer, 16). LEED has created an obstacle to building retrofit and reuse by undervaluing the ecological benefit and focusing on operational energy efficiency.

Maintenance Related Demolition:

Lack of appropriate maintenance can allow a building to become dilapidated, then perceived as inadequate for potential reuse and thus demolished. In order to cast some light on the reasons for demolition, the Athena Institute undertook a survey of buildings demolished in St. Paul, Minnesota for the period from 2000 to mid-2003. The scope of the survey included 230 commercial and residential properties, and focused on the age of the buildings the main structural materials, and the reasons for demolition (expressed in fig 3.1). About 70% of buildings demolished were in the 51-100+ age category, with 51% in the 76 and over bracket. The remaining 30% were all less than 50 years old, with 6% in the 0-25 age category. Lack of maintenance was cited as the specific problem for 54 of the buildings, and physical condition was the reason given for replacement. Only 8 cases contained a specific problem with structural or other materials or systems (Trusty, 10). Lack of maintenance is something that can be prevented, and should not result in demolition of a building. “The general practice of replacement rather than repair is well rooted in our modern industrialized society. Building maintenance particularly suffers as a consequence” (Fisher, 10).

Fig 3.1: Reasons for Demolition



Discussion of Barriers to Building Reuse:

"Whenever historic preservation comes up in public discourse, it seems, economic arguments figure prominently" (Mason, 1). The multitude of environmental benefits to building retrofit and reuse cannot be used as a viable defense against demolition and construction of a high performance building without an economic defense as well. The LEED rating system fails to support building reuse because the points are unevenly weighted. If LEED is to "facilitate meaningful comparisons, it must quickly evolve to include all products used for similar applications" (Bowyer, 16). Additionally, it is difficult to keep building reuse as an attractive option because of the consistently changing economy. Over the past fifty years, environmental interest has risen and fallen like tides on a beach in relation to the economy's well being. The connection between the two is unmistakable. When people have money, conservation is not a main concern, because it doesn't have to be. "Ironically, when the economy is weak, retention of historic material seemingly increases in rehabilitations as budgets are more constrained, and fewer changes occur" (Fisher, 10).

# CHAPTER IV:

# EXPLORATION OF THE ECONOMIC VIABILITY OF BUILDING REUSE

Building reuse conserves existing resources not only for primary sources of the cultures that created them, but also for their material value. “The economic benefits of historic preservation begin with resource conservation, by extending the useful service life of existing assets which also extends the benefit of energy and material resources embodied in them” (Smith, and Elefante 19-24).

Economic Gain Through Tourism:

Reinvesting in a building that it is a component of a town center creates the opportunity for future economic gain for the local economy. A historic downtown that features unique cultural and social attractions with their built environment draws tourists to visit. "Heritage (or cultural) tourism is consistently among the most popular and lucrative forms of tourism, generally ranking in the top three economic sectors of most states and nations worldwide" (Facca, and Aldrich 44). A recent study commissioned by the U.S. Cultural and Heritage Tourism and Marketing Council and the U.S. Cultural and Heritage Tourism and Tourism Industries found that heritage tourism contributes more than $192 billion annually to the U.S. economy, with 78% of all U.S. leisure travelers participating in cultural or heritage activities while traveling, translating to 118.3 million adults each year. "The vast majority of these travelers seek travel experiences where the destination's buildings and surroundings have retained their historic character" (Facca, and Aldrich 44).

The Degeneration of the Town Center:

Before World War II, the main street was the city's primary hub for commercial and social activity. The National Trust for Historic Preservation states that:

> "Downtown buildings usually had several tenants – typically a ground-floor retailer and, frequently, several upper-floor offices or apartments; together, these tenants provided enough rent for property owners to keep their buildings in good condition. The presence of the post office, library, banks and local government offices added to the steady flow of people downtown. Not only was Main Street the center of the community's commercial life, it was also an important part of its social life; people thronged the streets on Saturday nights to meet friends, see a movie and window-shop" ("What Happened to America's Main Streets").

The expansion of the highway system created the ability for suburban communities to grow and transform the way Americans work and live. The amount of citizens that made the trip to downtown for entertainment and interaction consistently decreased, causing local businesses to close and become dilapidated from neglect. The deterioration of town centers is a common occurrence across America. "There is a direct relationship between sprawl (excessive decentralization) and downtown vitality. Excessive suburbanization reduces 'the incentive to redevelop land near the center' contributing to the decline of downtown areas" (Faulk, 625). The community's unique heritage was forgotten along with the downtown destination culture. Sprawl reflected in the suburban communities created a void for sense of place and pride. Some communities have realized these issues and adopted strategies like the Main Street program and heritage tax credits as solutions to save their historic buildings and revive their community's commercial and business core.

The Main Street Program:

The Main Street Program has transformed the way communities think about the revitalization and management of their downtowns over the past thirty years. The National Trust for Historic Preservation developed this initiative for local communities to boost their economies by reinvesting in existing structures. Programs are locally driven, organized and funded with direction from the affiliated statewide organization. After a city is approved to be designated a 'Main Street Program', the statewide coordinating organization provides technology services, networking, and training to assist with the revitalization process. Financial support comes from local city government, public, merchants, and businesses; because of a local buy in, more people care about the success of the project. Many communities also raise money to hire a full time local Main Street Coordinator and create volunteer committees and a board of directors to carry out the work.

The Main Street program is an economic development tool consisting of a four-point approach and eight principles. The four points of the Main Street approach are organization, promotion, design, and economic restructuring; these points work together to build a sustainable and complete community revitalization effort ("The Main Street Four-Point Approach", n.d.). Organization requires citizens to work together toward the same goal, providing effective, ongoing management and advocacy for the downtown and business district. Promotion creates a positive image focusing on regaining community pride, thereby returning consumer and investor confidence in the commercial district. Design is creating an aesthetically appealing visual atmosphere that invites shoppers, workers, and visitors. Economic Restructuring reinforces the community's existing economic assets while expanding its economic foundation. The eight principles secure the Main Street program's success if followed correctly. They speak directly to each town attempting this restructuring specifically. The revitalization must be comprehensive, including all sectors of the downtown. It must be seen as an incremental process, this leads to longer-lasting and positive change. Residents and business owners must play a part and reinvest in the heart of their community, demonstrating the importance of community involvement. The public and private sectors must come together in partnership to achieve the common goal. Business districts must identify and capitalize on the assets that make them unique, giving each town their own cultural flavor. Quality change must be exhibited in every aspect and element of the project. Lastly, in order to fully attain success, visible results can only come from implementation and completing projects ("The Eight Principles", n.d.). This approach is comprehensive and applies to every city, no matter what region it resides in.

The success of the program has been proven in many cities and states. Texas adopted the program thirty years ago, and over those years, "more than 2.4 billion in reinvestment has been realized, along with the creation of more than 27,000 jobs and 7,100 small businesses" ("Main Street Matters", 1). In the past fiscal year, the Main Street communities of Texas reported "more than $171 million in overall reinvestment. Of that, almost $77 million comes from private reinvestment, signaling the confidence local entrepreneurs and property owners have in their Main Street communities…In this same period, close to 1,400 jobs were created and 359 businesses were created, expanded, or relocated in the Main Street district…During this period, 90,468 hours have been contributed to the program by Main Street volunteers...Using raw formulas, the overall value of volunteer time given over the current period is $1,932,396" ("Main Street Matters", 6-7).

In December 2001, a more comprehensive study was conducted in California by the Local Government Commission, a private non-profit organization. California initiated the program in 1985, since then 72 districts throughout California have implemented it and reaped the economic benefits. The study sought to determine the impact of a Main Street program on the local community by using the following data:

- Job creation
- Cost per job
- Downtown employment
- Business creation
- Vacancy rates
- Sales tax revenue
- Property values
- Crime rates
- Rent structures (retail, office, housing)
- Public and private reinvestment
- Return on investment (for every local dollar invested in operating a Main Street program, what was the return)
- Local program budget
- Volunteer hours

They found that the median population grew by 20% in the towns since their Main Street program was designated.

- The net number of businesses increased 24%
- The net number of jobs increased 31%
- The value of public improvements (buildings and infrastructure) made in each community was more than $2.2 million.
- The value of private building improvements in each community was nearly $3.9 million.
- The cost per job was $4,551. (The total money spent operating a local Main Street program divided by the number of net new jobs.)
- For every dollar a community invested in its Main Street program operations, $7.13 was invested in public and private improvements.
- Retail sales increased 105%.
- Commercial property values increased 167%.
- The number of local Main Street program volunteers increased more than 200%.
- Storefront vacancy rates declined76%.
- Taxable retail sales statewide increased 22% since 1988.
- Taxable retail sales statewide increased 77% since 1988, as compared to 105% in the 16 Main Street downtowns.
- The state's Consumer Price Index of inflation between 1988 and 2001 was 53%.

In addition to the statistical data, the citizens of the cities were surveyed showing that they were very happy with the Main Street approach and California Main Street. They were also very happy with the improvements that Main Street had brought about in their communities' appearance, levels of downtown economic activity, and the ways their community members work together to bring about revitalization (Eichenfield & Associates, 2002). This amount of progress in a weak economic climate speaks to the power and success of the Main Street program.

Maryland Heritage Structure Rehabilitation Tax Credit Program:

The Main program is by far the largest and most notable program to encourage retrofit and reuse building stock in town centers in the nation. However, it is directed more towards cities smaller in size. Some States have adapted the idea to their larger cities and created a program detailed to their needs. Maryland in particular, created the Maryland Heritage Structure Rehabilitation Tax Credit Program to encourage the redevelopment of historic properties in the state through offering developers tax incentives equal up to 20% of eligible rehabilitation costs. Baltimore's historic center of commercial activity is now the center of the city's economic and green resurgence as a result of "the most successful economic developed program every designed by Maryland state government" (Cronyn, and Paull ,1). The state program has provided powerful incentives for reusing older, underutilized, and otherwise economically obsolete buildings. The Maryland Heritage Structure Rehabilitation Tax Credit Program has initiated the reinvestment of 407 historic commercial structures over its life of twelve years. "These projects involved over $923 million in total rehabilitation spending by developers, assisted by an investment of $213.9 million in state tax credits (Cronyn, and Paull, 2). The total economic impact generated on the Maryland economy for the twelve years from 1997 to 2009, was more than $1.47 billion in total economic activity, employing an estimated 15,120 persons earning $673.1 million. During the construction periods alone, the 407 projects generated an estimated $83.7 million in state and local taxes, effectively paying down more than one-third of the state's total $213.9 million tax credit. "Though projects have ranged in their scale of total rehabilitation expenditures from $6,000 to $70.9 million, more than three-fifths (60.9%) of projects have involved spending of less than $500,000" (Cronyn, and Paull ,2). The research above that was conducted by Lipman Frizzell & Mitchell and Northeast-Midwest Institute, makes a clear case for rehabilitation by demonstrating the short- and long-term yield which the State of Maryland has received on its investment in its existing historic building stock. Because of this program, preservation was proven to be economically and environmentally sustainable by the creation of jobs and the saving of green fields. As this program continues and grows in momentum, "the Maryland economy will grow along a more sustainable trajectory and its citizens' quality of life will be enhanced" (Cronyn, and Paull, 7).

An Assessment of Program Implementation:

These studies together prove that a city's choice to retrofit and reuse their existing building stock can boost their economy for a sustainable period of time. The revitalization process is different for each city and the goal of these strategies is to develop a distinctive downtown where people will enjoy spending time and money. Projects are tailored to the specific needs of each community, and this is supported by the reuse of their existing building stock (Faulk, 643). Main Street has had a positive impact in communities across America by catalyzing rehabilitation and building reuse to benefit local economies. "Over 48,800 buildings have been rehabilitated in cities with Main Street Programs since 1980 in addition to substantial numbers of new businesses and jobs" (Faulk, 627). The jobs created by building reuse and retrofit exceeds the jobs created by new construction, with increased retail sales and amount of revenue returned to the communities (Rypkema, 12). Programs outside Main Street, such as federal tax credit programs, have also recognized economic benefits through generating a private investment of more than $20 billion (Fisher, 8). The types of studies examined in this chapter demonstrate the positive economic benefits of investment activities in existing building stock of tax credits, tourism, and Main Street revitalizing programs. "This is not to say the benefits are guaranteed, or that they always outweigh the costs of preservation" (Mason, 10). But these studies do present convincing evidence that "reuse pays" (or can pay) against new construction when viewed simply in economic terms.

The reasons behind these statistics are central to most rehabilitation. It creates more jobs and increases more economic competitiveness than new construction because retrofitting and rehabilitation creates a demand for more highly skilled workers. Talent and a more sought after class of workers are attracted to a more rich, diverse built environment with a firm sense of place and higher quality of life. Another proven aspect from these studies is that the reinvestment through reuse of buildings in town centers is friendly and supportive of small-businesses. In the United States, "small businesses are responsible for between 75% and 85% of employment and are a crucial driver of economic growth" (Frey, 2007). The saying holds true that small businesses are the backbone of America and historic buildings contain the ideal space for those businesses. From these results we can also see that building reuse promotes service-based economic development by creating more growth than new construction while using less natural resources. It also increases the property value of the commercial and residential land of the renovated building. Dollar for dollar, retrofitting and reusing a building is more economically sound than new construction.

# CHAPTER V:

# FINDINGS, DISCUSSION, AND A LOOK TO THE FUTURE

It is projected that by 2030, ¼ of our existing building stock will be demolished (Preservation Green Lab, 2011). That is if we keep on with our philosophy that the only sustainable solution is to start fresh. We created this need for greener buildings with our societal consensus of the motto 'everything is replaceable'. Allowing initial cost to influence our 'green' developmental decisions is a dangerous path that leads to a dilapidated society. The largest motivator for new construction is the money saved on energy expenditures. The energy spent in operation over the buildings lifetime overshadow the embodied energy. There is a bias throughout the green building community that if you want to achieve energy efficiency in a building you need to start from scratch. "Historic buildings have embodied energy that can balance the goal in the green building community for energy efficiency improvements that may be difficult to achieve otherwise" (Tess, 1). Building reuse takes full advantage of the energy over the lifetime of a building and the "true value of buildings is not realized until later generations benefit from them as well. It is the reuse of buildings that defines them in sustainable terms, far more than any green attributes they may have when first erected" (Smith, and Elefante 25). Building retrofit and reuse is "a powerful but underutilized community catalyst with history, the arts, and cultural heritage. They are elements of a community's quality of life, cultural economic development, and the expanding creative economy, smart growth, sustainability, and renewed interest in the power of local economies" (Facca, and Aldrich 39). The main enemy for sustainability is short-term thinking. Replacing a building because of the increased initial cost is short-term thinking with the economy as well as the environment. Reinvesting in buildings specifically located in town centers brings life back to downtowns and boosts the local economy. After extensive research and exploration of case studies, yes, building reuse can be as sustainable for the environment as well as more economical demolition and construction of a green building.

The Future of Design:

"In the U.S., approximately 15 million new buildings are projected to be constructed by 2015" ("The Dollars and Sense of Green Retrofits", 1). It is understood that not every building can be reused especially when some are damaged beyond repair. In the future, we can prevent this by building sustainably using historic methods. Historic buildings incorporate passive design, because it was necessary. We should mirror this in our methods of new construction. Strategies such as site design and the use of local materials will extend the life of buildings and take advantage of the climate. This will also define a sense of place with regional specific aesthetics from the design. Another way to deter from demolition would be to design a building with multiple purposes in mind. A major draw back to most buildings built since 1950, is that they were designed for specified purposes. Over the past thirty years, building technology and use have altered greatly and will continue to change as we grow. With a more flexible interior design, that welcomes future adaptive reuse, buildings will be less likely to be replaced. "The built environment is a human-made setting which provides the surroundings for human activities and interactions. It has the potential to develop and enhance or to destroy the environment" (GhaffarianHoseini, 37).

Translating Environmental Effects to Economic Expenditures:

While examining papers written defending building reuse, I realized that benefits and expenditures were discussed either in economic or environmental terms. There was a lack of information that compared an existing building retrofit to new construction using both evaluating methods together. This is a large oversight in the approach to sustainable development, the environment and economy are not two separate entities, they are intertwined and interdependent. "Sustainability is understood to deliver the 'triple bottom line' by considering ecology, economy, and equity simultaneously" (Smith, and Elefante, 22). Negative effects to the environment will almost always translate into economic expenditures, creating in most cases a solid defense for building reuse and retrofit over new construction.

These are not obscure issues, their effects on the environment are well known, but they will also affect the economy. The amount of carbon dioxide released is counterproductive to preventing global warming. Carbon dioxide is a large contributor to global warming, pollution, and the depletion of the ozone layer. "Ozone-depleting compounds (ODCs) are gases associated with the destruction of the ozone layer. These gases are most commonly found in foam materials such as insulation and some adhesives" (Meryman, 32). The hole in the ozone has notable consequences to the wellbeing of crops, humans, and animals. Damage to crops and animals equals decrease in the amount of food available, resulting in a higher purchasing cost. The inability of the ozone to filter UV rays increases the chance of skin cancer, conversely increasing the amount spent on health insurance and hospital visits. Extraction of construction material creates “Hazardous air pollutants (HAPs) that are known or suspected to cause cancer or other serious health problems; they run the gamut from benzene to arsenic to coke-oven emissions” (Meryman, 32). HAPs combined with the pollution from overflowing landfills, greatly increases risk for health problems and money spent on medical bills. Chemicals from construction waste contaminate groundwater, further decreasing our limited stock and increasing the money spent because of health complications and lack of resources. Additionally, the massive amount of waste created as a result of demolition has to be put somewhere. It is unknown how much money it will cost to find additional places to put our trash and what harmful substances might be included. The damage we do to the environment will end up coming out of our wallets as well as our health.

Urban sprawl is a perfect example of a problem that effects both environmental and economic. Sprawl keeps a person in the driver’s seat. When a commuter makes an hour’s drive to and from work spends the equivalent of 500 hours, or twelve workweeks, annually in a car. A byproduct of traffic delays is that more than 72 billion dollars in fuel and productivity is wasted (Mitchell, 2001). The quantifiable effects of urban sprawl provides a solid foundation for New Urbanism, and more importantly, the reuse and renovation of existing infrastructure.

> “Nearly 30% our income on car payments, gas, maintenance, and insurance. A great majority of our tax dollars go towards the endless building of roads and highways, with little left for valuable things like education, civic buildings, quality architecture and public spaces, or the building of new modern train systems. Our futile attempt to make the car happy is draining our national economy as well as our own personal savings. In addition, highway and airport gridlock is strangling

> our national and regional economies as more and more time is wasted stuck in traffic. This greatly reduces our nation's productivity while raising the cost of doing business for everyone" ("Creating Livable Sustainable Communities").

In addition to the effects caused by travel, the widespread development of surburban areas is claiming farmland at a rate of 1.2 million acres a year (Mitchell, 2001). Farming requires a large amount of land, especially grazing land for cattle and other livestock. The defining line between urban and rural areas is becoming more opaque with every passing year. In order for the nation to have the ability to provide the adequate amount of food for its population, land needs to be dedicated to agriculture. As the access to one type of food drops, the price skyrockets with the demand.

The adverse effects from extracting resources are permanent as well as the depletion of fossil fuels cannot be regained with a more efficient building. These environmental consequences will become economic concerns in the near future. Our lackadaisical approach to conserving non-renewable resources has decreased our supply significantly in the past fifty years. A lower supply with a high demand will result inevitably in a higher purchasing cost. "In the world according to neoclassical economics, as a heavily exploited natural resource becomes scarce its price increases, making investment in finding or inventing a substitute increasingly attractive" (Callicott, and Mumford, 35).

An Integrated Approach to Sustainability:

As stated in the introduction, sustainable development should focus around meeting the needs of the present without compromising the ability of future generations to meet their needs. The Bruntland Report outlines specific ways that a society may compromise its ability to meet the essential needs of its people in the future, one being the overexploitation of resources. The Pocantico Proclamation in 2009 pointed out that our current economy is based upon unsustainable consumption and overreliance on finite resources. In order to make progress toward sustainable development, our economy must manage natural and cultural resources in a sustainable and economically beneficial manner. "Sustainability embraces the interrelations of human and the environment based upon the adjustment of actual needs of human including social, cultural, environmental and economic needs and points out the necessity to conserve the natural resources" (GhaffarianHoseini, 37). However, the economy seems to be the prevailing strategy, translating energy efficiency to cost efficiency. The environment needs to be recognized as the precondition for the economy as well as the society. Without the planet's basic environmental life-support systems, there can be no economy or society (Levett, 295). Sustainable development requires the unification of economics and ecology. The two philosophies of building reuse and sustainable design share many common practices and goals, but there remains a good deal of hard work ahead in order to achieve both objectives with balance. Green building technology promises to reduce environmental harms caused by new construction, but existing buildings feature traditional building practices that provide a wealth of sustainable design solutions all of which provide essential models for the future. In order to guarantee equal comparability to new construction, older and historic buildings must also be retrofitted to include energy efficient technology in addition to inherent advantages. "Long-term concern with the natural environment and the slow but continuing push of the sustainability movement may someday help promote repair over replacement of building material" (Fisher, 10).

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