A COMPARISON OF RESIDENTIAL GREEN BUILDING PROGRAMS

By

Alicia J. Miller

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The members of the Committee appointed to examine the thesis of ALICIA J. MILLER find it satisfactory and recommend that it be accepted.

_____
Michael Wolcott, Ph.D., Chair

_____
William Budd, Ph.D.

_____
Nicholas Lovrich, Ph.D.

A COMPARISON OF RESIDENTIAL GREEN BUILDING PROGRAMS

Abstract

by Alicia J. Miller, M.S.
Washington State University
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Chair: Michael Wolcott

Within the arena of green building programs, significant differences in the effectiveness of the programs are in evidence. Differences also exist between how programs measure sustainability, the goals they wish to accomplish, and the local social and political climate within which they exist. First, the paper examines the residential green building programs' environmental matrices. Second, an analysis of green building programs is compared to an analysis of the success of local government sustainability promotion efforts within the cities where they are located. Third, the paper examines the efforts that have taken place within Seattle, Washington that encourage residential green building.

The findings of this paper suggest that residential green building programs, although differing somewhat in their goals how they measure sustainability, can be compared effectively. It was also found that well-established programs (programs a decade old or greater) that are located within cities that encourage sustainability are more successful than similar mature programs located within cities that have done less to encourage sustainability. Cities that take a comprehensive approach through regulatory

measures, economic incentives, permitting incentives and public education and awareness also tend to feature more successful green building programs.

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INTRODUCTION

In the last decade a large number of residential green building programs have been established in cities across the United States. These programs can be said to have revolutionized the sustainable development movement across the nation. Numerous cities have enacted ordinances promoting such programs. These programs are seen by scholars who study urban affairs as an indicator of how well cities are doing in their goal to promote sustainability. As the process of green development becomes more of a mainstream phenomenon, it is important to research its progression and the diversity of implementation that has occurred on the local level.

"Today (2003), there at least twenty-five major cities in the United States that have invested significant amounts of time, resources, and political capital in the development of initiatives to pursue some form of sustainability" (Portney, Preface, 2003). Portney continues after making this observation, "little serious, hypothesis-driven research has been conducted to examine these cities' programs and initiatives" (Preface, 2003). Since 2003 a bit more research has been done into urban area sustainability promotion, but still minimal amounts of objective, critical research within the field of residential green building programs is present in the research literature.

"Green building represents one strategy for reducing human impact on the environment," (Winter, 2008, pg. 2). The emphasis on green building is indeed growing, and a lot of room for improvement remains in the residential construction sector. The EPA Green Building Strategy found that "buildings account for: nearly 40% of U.S. energy use, about 40% of U.S. carbon dioxide emissions, over two-thirds of all non industrial secondary materials generated in the U.S., more than 10% of U.S. freshwater

usage, health risks from indoor environments -- where Americans spend nearly 90% of their time." ("EPA Green Building Strategy," 2009).

By systematically comparing cities based on the proportion of houses that have been built by residential green building programs I hope to add to the scant research literature available. I hope to provide evidence of the current state of affairs with respect to their residential green building, providing a documented baseline for future comparisons.

In February of 2008 **Cities: The International Journal of Policy and Planning** published an article entitled "Cultural Sources of Variations in US Urban Sustainability Attributes." It addressed the variation between nearly 49 individual U.S. cities' sustainability practices and ranked those cities based on sustainability efforts (culminating in a sustainability index) within five distinct areas: environmental quality, public health, economic vitality, countering urban sprawl, and the scope and range of local policy and planning initiatives. Within each area data were collected and analyzed to determine the degree of sustainability being achieved. Then, the study used data that were collected for market research and advertising purposes within the same cities to determine attitudes and beliefs and permit the characterization of the overall political culture of the city. The article addressed three basic dimensions of political culture: Daniel Elazar's historical legacy, Robert Putnam's social capital, and Richard Florida's creative class phenomenon. Finally, the study used a multiple regression analysis to look for a relationship between cities that scored high on the sustainability index and cities that exhibit political cultures that where hypothesized to assist in the effective mobilization of sustainability efforts.

For the purposes of my thesis, the ten cities scoring at the top and the bottom of the sustainability index calculated for the 49 cities are the subject of close attention. The top five cities included: San Francisco, California; Seattle, Washington; Salinas, California; Minneapolis, Minnesota; and San Louis Obispo, California. At the bottom of the index were: Long Beach, California; Baltimore, Maryland; Wilmington, Delaware; Saint Louis, Missouri; and Houston, Texas. The analysis of the green residential building programs present in these cities will add importantly to our understanding of how that important aspect of sustainability promotion relates to other efforts to promote sustainability in these U.S. cities.

This thesis will use the following definition of sustainability employed in the Budd et al. article in **Cities** -- namely, the 1987 World Commission on the Environment and Development definition of sustainability which holds; "At its core, *sustainability* refers to the manner in which the physical, social, economic, and environmental needs of a community are met without compromising the ability of future generations to meet their own needs" (Budd et. al, 2).

The definition of green building varies slightly from one green building program to another, but substantial overlap in concept is clearly present. This thesis will use the following definition derived from "A comparative analysis of two building rating systems," an analysis presented in the *Institution of Civil Engineers*.

> *Green Buildings may be considered as structures that incorporate environmentally sensitive features and technologies from the initial design phase; they seek to meet or exceed resource and energy consumption targets that are set well above local requirements while taking into account the whole life cycle impact of the structure. (Fenner et al., 2008, pg. 55).*

This thesis will include several sections. The initial chapter features an introduction to residential green building programs. It describes the history of their development and sets forth the framework of these programs, and presents an analysis of how these programs can be compared and contrasted.

The second chapter is made up of an overview of "Cultural Sources of Variations in US Urban Sustainability Attributes" (Budd et al., 2008), and a study of the success of residential green building programs within the top five and bottom five cities identified by the "Sustainability Index." The chapter also reports on detailed research done on two cities quite differently ranked on the "Sustainability Index" with established residential green building programs as a deeper and more revealing comparison of these programs.

The third chapter evaluates cities' polices that address residential green building. The chapter will focus on Seattle, Washington, given that King County, Washington (the county in which Seattle resides) had the most residential green certified homes per new home start in the period 2006-2009.

The final chapter will address the question of which attitudes, beliefs, and policies tend to promote residential green building. It will also discuss how having a well-established program affects the success of the program.

CHAPTER ONE

RESIDENTIAL GREEN BUILDING PROGRAMS

Introduction

Sustainability has become increasingly important in the building industry in recent years. Within the US the municipality of Austin, Texas was the first major urban area to draw a correlation between efforts to assist homebuilders to create green homes and decreasing the need for energy production. After realizing the success of Austin's green building program, many other cities, environmental organizations, and homebuilders followed suit by creating their own residential green building programs. These programs tend to make use of the same *checklist framework*, and tend to certify greenbuilt homes a very similar manner.

In his book Design With Climate, Victor Olgyay discusses how civilizations of the past built homes that fit within the climate around them. From Alaskan Eskimos surviving in igloos to Pueblo Native Americans creating adobe structures, civilizations of the past have survived by adapting to their environment (pg. 4-5, 1963). The modern US has a rather wide variety of climates, yet a fairly uniform building design tends to predominate -- made possible principally by HVAC technology and equipment (p.10, 1963). In 1963 Olgyay argues that architects need to spend time learning about the regional climate conditions of the area in which they work, and then design structures with those conditions in mind.

The building technologies developed in the 1930's paved the way for the construction of huge buildings made out of glass windows and steel, or "glass box" buildings. It has been noted that "the advent of air conditioning, low wattage fluorescent

lighting, structural steel, and reflective structures that could be heated and cooled with massive HVAC [Heating Ventilation and Air Conditioning] systems, thanks to the availability of cheap fossil fuels" made it possible for glass box buildings to become the norm ("White Paper on Sustainability," 2003, p. 4). However, when energy became substantially more expensive in the 70's because of oil embargoes and the cartelization of fossil fuel exploitation innovators working in the areas of construction design, civil engineering and architecture were under considerable pressure to come up with new and improved designs to help reduce energy costs and promote natural resource conservation.

Green Building Codes:

The nation's many green building programs were brought into existence for a variety of local context reasons, and consequently have differing origins reflecting somewhat conflicting values and goals. They have diverse roots within national and regional environmental nonprofit organizations, local homebuilders associations, and their local municipalities. The underlying values and goals of these organizations will continue to shape the future of green building in the US.

While the range of variation among of programs is considerable, two major categories of green building programs can be identified; national and regional. The two national programs in operation are the US Green Building Council's LEED for Homes, and the NAHB's [National Association of Home Builders] National Green Building Standard. It is estimated that there are as many as 85 different local and regional programs (Winter, 2008, p.12). Regional programs are often closely aligned to regional climates. For example, in Austin the majority of a home's energy use may go toward

cooling costs, and in Denver the majority may go towards heating costs. The checklists for these areas would attempt to increase the energy efficiency of homes in different ways. One example of contradictory credits involves the use of skylights. Austin Energy Green Building discourages the use of skylights, and Built Green Colorado encourages it. "In Central Texas having a skylight in a house is much like punching a hole in the roof and letting the sun's heat pour in…" ("Guide to the Single-Family Home Rating," 3.18). Within Built Green Colorado's checklist one point is awarded per skylight, with a maximum of two (Energy Efficient: Lighting).

LEED for Homes has one checklist that covers the entire country, with no region-specific credits. This sole checklist facilitates builders' operations when working in more than one regional market. "While there are already a number of local or regional green home building programs, LEED for Homes is attempting to provide national consistency in defining the features of a green home and to enable builders anywhere in the county to obtain a green rating on their homes," ("Pilot Rating System version 1.11a," 2008, p. 5). Where green building programs tend to overlap is in the measurement processes they use. Each green building program uses rather similar criteria to rate and identify green building practices.

Residential Green Building codes generally follow the same general format. They consist of a checklist made up of points or credits that are divided into distant categories. Typical categories consist of: site planning, energy efficiency, water efficiency, materials and resources, indoor air quality, and homeowner education.

Examples of site planning credits include: not developing on flood plains, keeping as many trees on the site as possible, erosion and sediment control standards, and

orientation of the home vis-à-vis the sun's trajectory. Energy efficiency credits generally include measures for extra insulation that increase the energy efficiency of the home, and making use of energy star appliances within the home. Water efficiency measures usually include installing low flow features, and the use of native or drought-tolerant plants. Credits are usually given for the use of low VOC (volatile organic compounds) paints, and composite woods made without urea formaldehyde under the category of indoor air quality. The homeowner's education portion of the checklist usually includes a manual for the homeowner that covers the maintenance and operations instructions for the homes, and a walkthrough for the homeowner by the builder.

Most residential green building programs include some features that are **required** for the home to be certified. These particular credits on the checklist are called *prerequisites*. The particular prerequisites listed differ depending on the program, but usually include some type of energy efficiency requirement.

Several residential green building programs require homes to meet Energy Star certification guidelines. Energy Star is a program lead by the joint efforts of the US Department of Energy and the Environmental Protection agency. Certain energy-efficient household items such as washing machines and light bulbs can be energy star certified ("About Energy Star," 2009). Energy Star also has a checklist that qualifies an entire home for certification. Homes that are certified have effective insulation, high-performance windows, tight construction and ducts, efficient heating and cooling equipment, efficient products (energy star appliances), and third party verification through on-site inspection.

Green building programs typically fall into one of two types of certification process categories: performance-based or prescriptive-based programs. Performance-based programs focus credits on **goals** they want achieved and give options and suggestions on how to meet those goals. Such performance-based programs typically include fewer prerequisites that are more flexible than prescriptive-based programs. In his book The Sustainability Revolution Andres R. Edwards argues that the success of LEED has been the result of its performance-based framework. He noted in this regard, "these frameworks couple principles with criteria and methodologies that, though not prescriptive are rigorous, well defined and easily implemented," (Edwards, 2005, p.127). Prescriptive-based programs, in contrast, include many more prerequisites and are typically permit far fewer options.

Performance-Based Programs:

The first green building rating system to arise within the US came out of sheer necessity. Austin, like many other U.S. cities, owns the utilities provided to residents and businesses within the area. In the 1970's Austin had a choice to either buy a share of a nuclear plant or develop a way to decrease their energy dependency. The plan that arose from their energy crisis involved a carefully considered combination of the two options; Austin bought a share in the South Texas Nuclear Project and, in 1985, implemented the Austin Energy Star Program. In 1991 the program was renamed and it became Austin's Green Building Program, and thusly the first-ever U.S. Residential Green Building rating system was created. The rating system has evolved somewhat since 1991, and the Austin

Green Building Program became the charter member of the USGBC [US Green Building Council] in 1994 ("Austin Energy Green Building- A Concise History," 2009).

Austin Energy Green Building was "the country's first comprehensive program to encourage using sustainable building techniques in residential, multi-family, commercial, and municipal construction," ("Austin Energy Green Building- A Concise History," 2009). The Austin municipal government clearly wants to reduce the demand on their energy through green building.

Currently, the Austin Energy Green Building Program has separate assessment programs rating multifamily, residential, and commercial buildings. Homes are rated from one to five stars. The rating system covers the following environmental categories: energy, water, materials and products, health and safety, and community. As in many regionally specific programs, Austin's green building program focuses on building houses and apartments that will be efficient for their region. Central Texas is hot and humid most of the year, and homes that are being built using the code are encouraged to design for that type of climate. The code discourages the use of turf grass because it requires excessive watering to survive in the area, encourages rainwater harvesting, and encourages the construction of a front porch and a second porch. The porch is encouraged for several reasons; one of them "promotes interaction with neighbors and increases neighborhood security and sense of community," ("Guide to Single-Family Home Rating," 2008, p. 23). Several credits include points for building to ADA (American's with Disabilities Act) Standards, which is not addressed in many other codes.

The Austin code has sixteen prerequisites. If all sixteen are met, the home qualifies for a one star rating. The prerequisites include: using energy-efficient heating,

cooling systems (or air conditioning in layman's terms), and windows. The program requires insulation to meet minimum efficiency guidelines. There is a prerequisite for showers that are ready for the installation of safety rails. There are specific ventilation requirements. For example, one prerequisite requires the installation of a minimum of two ceiling fans per home. Another requires the home to be outfitted with energy efficient light bulbs. As in many green building codes, the use of low VOC (volatile organic compounds) paint is required. Efficient toilets are required, as well as the use of climate-appropriate plants and planting beds. The final prerequisite requires that the home meet the appropriate local government zoning and building codes for the area ("Guide to Single-Family Home Rating," 2008).

The green building program in Austin claims to certify approximately one third of all homes built within the Austin metropolitan area. The success of the Austin program made it a model for several green building programs that followed in other cities. Chuck Manning, Austin Energy's General Manager, stated that, "Austin is an environmentally progressive community with a strong quality-of-life emphasis," ("Austin In Forefront Of Green Power Movement," 2005).

Austin's program left many cities with the urge to replicate their success. Created in 1995, Built Green Colorado was a sustainability-promoting program brought together for the purpose of seeking to "encourage homebuilders, multi-family builders, architects, and developers to use technologies, products and practices that will provide greater energy efficiency and reduce pollution, provide healthier indoor air, reduce water usage, preserve natural resources, and improve durability and reduce maintenance," ("Welcome," 2009).

Built Green Colorado was formed by a partnership between the Home Builders Association of Metro Denver and the Colorado Governor's Office of Energy Management and Conservation. The program allows for a wide range of options to achieve a green building certification. Homes within the program are rated on a scale from one to five stars. The program covers environmental categories of site and water, energy efficiency, indoor air quality and material selection. The program includes eight specific prerequisites. To qualify for Built Green Colorado certification homes must meet the requirements for Energy Star certification. For all other prerequisites, the builder must choose one option within specific categories.

In 2003, Built Green Colorado was voted the nation's best green building program by the National Association of Home Builders (NAHB) Research Center ("Committees," 2009). Currently, the award-winning program has suspended all certifications due to budget cuts occasioned by the collapse of the housing industry in the current recession. The organization hopes to be back up and running eventually, but it is unclear what the future will hold for the program until the homebuilding industry returns to a more normal level of activity.

Using the Colorado Built Green program as a model, The Master Builders Association of King and Snohomish Counties in the Washington formed its program titled Built Green of King and Snohomish Counties in 1999. The mission of the organization is to "serve as the driving force for the use and consumer demand for environmentally sound design, construction and development practices in King and Snohomish Counties' cities and communities," ("Program," 2009).

The program has several certification levels, ranging from two to five star certifications. Originally there was a one star certification level, which required meeting prerequisites, however, that practice was ended in 2007. The process includes categories for codes and regulations, site and water, energy efficiency, health and indoor air quality, and materials efficiency. Every home built within the ambit of the program has to meet certain prerequisites. These prerequisites include meeting Washington State codes for energy, storm water management, water efficiency, and ventilation and air quality ("Single-Family/Townhome New Construction, Self-Certification Checklist," Version 2007).

Unlike the USGBC's approach to regulation, Built Green Washington is opposed to government regulations exercised within the building market. Their promotional material clearly states that the organization would like to "promote safer, healthier buildings through: using a non-regulatory market–driven approach to optimize the use of innovative industry-based solutions to potential environmental problems and minimize impacts of constructions, design, and development," ("A Handbook For Built Green," 2007, p. ii).

The United States Green Building Council (USGBC) designed LEED (Leadership in Energy and Environmental Design) with help from the National Resources Defense Council (NRDC). The USGBC is a nonprofit environmental group. The main goals of the USGBC are to become a leader within the green building movement, and to curb the damage to the environment that can occur without a managed market structure ("USGBC," 2008). In 1998 the USGBC launched a pilot program that it called LEED (Leadership In Energy and Environmental Design). This program has become extremely

successful and highly influential within the US; however, despite its overall appeal and widespread success there have been many critics and thoughtful critiques of the program have been formulated. For example, Shendler (2005) has observed in this regard with respect to LEED version 2.1: "We're concerned that LEED has become costly, slow, brutal, confusing, and unwieldy, a death march for applicants administered by a soviet-style bureaucracy that makes green building more difficult than it needs to be, yet has everyone genuflecting at the door to prove their credentials." ("LEED Is Broken-Let's Fix It," Shendler, 2005).

Since the noteworthy success of LEED for New Construction, the USGBC has launched several rating systems to tackle other forms of infrastructure development. LEED For Homes is a fairly new program, and was not officially launched until February of 2008 (However several homes were built under its pilot program). LEED for Homes "targets the top 25% of new homes with best practice environmental features." ("Pilot Rating System Version 1.1a," p.5, 2007).

LEED for Homes covers the categories of: innovation and design process, location and linkages, sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, and awareness and education. There are eighteen prerequisites specified under this program. For a house to qualify for LEED for Homes certification it has to meet the Energy Star for homes requirements, and have at least three Energy Star light fixtures. Prerequisites also include mandates for: erosion control during construction, the elimination of invasive species on the site, a homeowners manual and walkthrough, and third party verification ("Pilot Rating System Version 1.1a," 2007).

The USGBC has taken the position that they would like to "advocate for effective and comprehensive green building policy and codes at all levels of government," ("USGBC," 2008). The USGBC believes that current green building programs are not entirely sustainable, and the organization is "prepared to evolve as needed to mobilize and lead the building community's contribution to the transformation toward sustainable communities," ("USGBC," 2008).

Build it Green is a program that was formed in 2005 through a "merger of the Green Resource Center (est.1999) and San Francisco Bay Area Build It Green (est.2003) ("history," 2007). Build It Green is a "non-profit whose mission is to promote healthy, energy and resource efficient buildings in California," ("Single Family GreenPoint Rated Checklist v3-1.7," 2007). Homes are given a numerical score based on the amount of points the home earns under the program's official checklist. Homes must achieve at least 50 points for certification under the Green Point Rated program. The average score for reviewed projects is 113, and the current highest score earned is 309 ("Find Homes," 2007).

The program covers the categories of community, energy, indoor air quality, resources, and water. There are three prerequisites, and minimum point values that must be achieved within each category. Prerequisites include a credit for minimum energy efficiency, 50% of all construction waste coming from the site must be diverted from the landfill, and GreenPoint Rated credits must be incorporated into the blueprints for the project ("Single Family GreenPoint Rated Checklist v3-1.7," 2007).

Conceding to market pressure, the NAHB has also been developing programs to compete with existing local programs. The NAHB or National Association of Home

Builders is an umbrella organization to which state and local homebuilders associations pay dues for membership. The organization provides services to local builders associations, it provides market research, it educates the public on housing issues, and the organization lobbies the government and works with government agencies on behalf of builders ("Our Organization," 2009). At the present time, "NAHB's builder members construct about 80 percent of the new homes built each year in the United States," ("Our Organization," 2009).

In Canada, where Green Globes dominates the commercial market, this organization has a residential program that is equally as important as that of the NAHB. Within the US The Green Building Institute (GBI), a not-for-profit organization, worked with the Canadian Green Globes program and the National Home Builders Association (NAHB) to develop "NAHB Model Green Home Building Guidelines" ("About GBI," 2009).These guidelines have been implemented on the local level by some home building associations. "These guidelines are intended to serve as a tool kit for home builder associations to create new programs and to help those programs expand and flourish," ("NAHB Model Green Home Building Code," 2005).

NAHB's latest contribution to the residential green building sector is the National Green Building Standard; this standard document was built off of the foundation of the NAHB Model Green Home Building Code. This code was released in a partnership with the International Code Council and is the first code of its kind to become certified by the American National Standards Institute (ANSI) in January of 2009 ("National Green Building Standard," 2008).

In 1996 BREEAM (Building Research Establishments Environmental Assessment Method), the environmental assessment method that dominates the European market, and CSA (Canadian Standards Association) launched BREEAM Canada. In 2000 BREEAM Canada became Green Globes for Existing Buildings (which is similar to LEED within the US). In 2004 GBI (Green Building Initiative) acquired the rights to Green Globes certification within the United States ("What is Green Globes?" 2009). "The Green Building Initiative was originally conceived as a way to bring green building into the mainstream by helping local Home Builder Associations (HBAs) develop green building programs modeled after the National Association of Home Builders' (NAHB) Model Green Home Building Guidelines," ("About GBI," 2009).

The Green Building Initiative's "mission is to accelerate the adoption of building practices that result in energy-efficient, healthier and environmentally sustainable buildings by promoting credible and practical green building approaches for residential and commercial construction ("About GBI," 2009).

The Greater Houston Builders Association has partnered with the Green Building Initiative to bring residential green building to Houston in 2005 ("Local Home Builders Launch New Green Building Program," 2005).

The Builders Association states that they "are the voice of Houston's Residential construction industry, serving our community by educating and advocating professionalism and quality housing, ("Mission and Values," 2009). The checklist for Houston's GBI includes the categories of site development, materials, energy, health, water, and operations, maintenance, and homeowner education. The energy portion is made up of one required credit that mandates that the home "exceeds latest version of

International Energy Conservation Code (2001 IECC) by 15% or be certified Energy Star home," ("Green Building Initiative Guideline Checklist," 2005). There is also a minimum point value required within each category, totaling twenty-five prerequisites. Homes are certified on a pass-fail basis. Those homes that meet at least twenty-three of the twenty-five prerequisites, but cannot meet the other "due to circumstances beyond my control, i.e., government regulations, supply problems," ("Green Building Initiative Guideline Checklist," 2005) can still be certified.

The Home Builders Association of St. Louis and Eastern Missouri partnered with the Green Building Initiative to create a checklist for the St. Louis area in 2005 ("Green Building," 2009). The mission of the Home Builders Association of Greater St. Louis and Eastern Missouri specifies that it "help create a region that promotes and protects the viability of the building industry by serving its members, who strive to meet the housing needs of our neighbors," ("About Us," 2009).

Categories included within the St. Louis checklist are as follows: lot design, preparation, and development, resource efficiency, energy efficiency, water efficiency, indoor environmental quality, operations, maintenance, and homeowner education, and global impact. The prerequisites listed under the St. Louis checklist are similar to those of Houston because they are both modeled after the NAHB Model Green Home Building Guidelines. There are a certain number of credits within each category that are required (these numbers vary depending on which certification level is being obtained), and there are energy performance credits that are required for every project.

Performance-based programs may present more higher initial costs from the necessary energy modeling and design tasks by engineers and architects. However, this

method is often more flexible in ways to achieve credits, and may lead to increased innovation with higher levels of efficiency. In the same respect, prescriptive-based programs that allow little flexibility may have lower initial costs and are often easier for a municipality to enforce due to the more ridged nature of the program.

Prescriptive-Based Programs:

The California Green Builder program differs somewhat from other green building programs across the nation. The Building Industry Institute, an organization that represents the California construction industry, formed the program ("Who We Are," 2009). The program certifies homes on a pass-fail basis. The checklist is composed of solely mandatory requirements. Homes certified within the program are required to meet the California Green Building Standards Code. This code was developed to help buildings within California to become more sustainable, and will be required for all new homes built within California in January of 2011. The standard requires the use of low VOC products, a Storm Water Pollution Prevention Plan, construction waste be diverted from the landfill, mandatory energy performance, and some plan to reduce water use. Other requirements under the California Green Builder Program include advanced ventilation requirements, and water and wood conservation requirements ("CGB Rater Field Verification Form," 2009).

Minnesota GreenStar is a relatively new prescriptive program. The program originated in 2005 as a collaboration between the, "Builders Association of the Twin Cities, the National Association of the Remodeling Industry, The Green Institute, the University of Minnesota Center for Sustainable Building Research, Building Knowledge,

Xcel Energy, and Minnesota Department of Commerce," ("What Is MN Greenstar," 2009). The mission of the organization is to, "advance Green design and construction in Minnesota's residential sector ("What Is MN Greenstar," 2009). They state that they were "born out of the desire to create something beneficial to everyone…something desirable, accessible and available to all," ("What Is MN Greenstar," 2009).

The organization's pilot program was released in September of 2007, followed by the launch of their official checklist in May of 2008. The program certifies homes in three levels: Bronze, Silver, and Gold. There are 88 prerequisites that range from requiring all carpets to be certified as "low-emitting" by a third party, to mandating carbon monoxide detectors. As of April 2009 there were eighteen homes certified within the program ("Certified Projects," 2009).

Semi-prescriptive Programs

EarthCraft House is a residential green building program that covers the Southeastern United States. They strive to be the "blueprint for healthy, comfortable homes that reduce utility bills and protect the environment," ("EarthCraft House and Low-rise Multifamily Technical Guidelines," 2005, p. 3). The program was created by a partnership between the Greater Atlanta Home Builders and the Southface Energy Institute in 1999.

EarthCraft House attempts to be very flexible in certifying homes, "there are many ways to reduce pollution and the waste of natural resources when building…" They continue in this vane by observing: "Technical Guidelines are intended to illustrate broad design and construction guidelines and are not to be used as design or construction specifications," ("EarthCraft House and Low-rise Multifamily Technical Guidelines,"

2005, p. 2). “Any size and type of home can be certified EarthCraft House by following the technical guidelines of the program,” (“EarthCraft House and Low-rise Multifamily Technical Guidelines,” 2005, p. 3).

The homes can be certified on several levels: Certified, Select, or Premium. The program covers these categories: site planning, Energy Efficient Building Envelope and Systems, Resource Efficient Design, Resource Efficient Building Materials, Waste Management, Indoor Air Quality, Water Conservation, Home Owner Education, Builder Operations, Bonus/Innovation Points (“EarthCraft House and Low-rise Multifamily Technical Guidelines,” 2005).

The EarthCraft program entails forty prerequisites. The prerequisites cover complying with local building codes, attending a formal workshop on erosion and sediment control during construction, and minimum efficiencies for windows and insulation. Homes are required to reach Energy Star new home certification. The program also requires that, “no construction material should be burned or buried on job site,” (“Mixed Humid Climate Worksheet,” 2008).

Conclusion

The established residential green building programs vary greatly with respect to the stated mission, goals and prerequisites. However, the programs are similar in the target design areas and in the use of demonstrable means of compliance. Employing and tracking a green building program can provide a basis for municipalities to measure their progress in sustainable development goals.

Table 1.1: Side-By-Side Comparison of Green Building Programs 1

	NAHB NGBS	LEED H	Build It Green	CA Green Builder
Full Program Name	National Association of Home Builders (NAHB) National Green Building Standard (NGBS)	Leadership in Energy and Environmental Design for Homes	Build it Green: Green Point Rated	California Green Builder Program
Coverage Area	National Program	National Program	California	California
Year of Origin	Received ANSI approval in Jan. 2009	Officially Launched Feb. 2008	2003	2005
Certification Levels	Bronze, Silver, Gold, and Emerald	Certified, Silver, Gold, Platinum	Homes are differentiated based on points received.	Homes are certified on a pass/fail basis.
Prerequisites	22 Prerequisites	18 Prerequisites/ 129 points	Minimum Point totals required for each environmental category.	15 standards, all required
Environmental Categories	Lot Design, Preparation, and Development; Resources Efficiency; Energy Efficiency; Water Efficiency; IAQ; and Operation, Maintenance and Homeowner Education	Innovation and Design Process, Location and Linkages, Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, IAQ, and Awareness and Education	Community, Energy, IAQ/ Health, Resources, Water	Energy, Water, Wood, Indoor Air, Waste, Inspection, CA Code
Use of Verifiers	Third Party Verifiers	"The Green Rater must conduct an in-field final inspection"	Third Party Verifiers	Third Party Inspections
Fees	$200 per building for NAHB members; $500 for non-members. Additional $20/unit for multi-unit projects.	Builders: One time registration fee of $150	Range from $700-$1500 for single family home	$60 per unit

Table adapted from Dovetail article

Table 1.2: Side-By-Side Comparison of Green Building Programs 2

	Built Green WA	MNgreenstar	Earth Craft House	Built Green Colorado
Full Program Name	Built Green Washington	Minnesota GreenStar New Homes and Remodeling Standard	Earth Craft House	Built Green Colorado
Coverage Area	Washington*	Minnesota	Southeastern U.S.	Colorado
Year of Origin	Original Built Green steering committee came out with a checklist in 1999.	Checklist launched in 2008.	Program Created in 1999.	Introduced in 1995
Certification Levels	Two-Five Star (As of the 2007 revision there is no one star rating)	Bronze, Silver, and Gold	Certified, Select, and Premium	One-Five Stars
Prerequisites	Prerequisites depend on star level, and minimum requirements within each category.	88 mandatory prerequisites for homes	40 prerequisites	Prerequisites depend on star level, and minimum requirements within each category.
Environmental Categories	Codes & Regulations, Site & Water, Energy Efficiency, Health and Indoor Air Quality, and Materials Efficiency	Energy Efficiency; Resource Efficiency (including durability); Indoor Environmental Quality; Water Conservation; and Site and Community Impacts	Site Planning, Energy Efficiency, Resource Efficiency, Waste Management, IAQ, Water Efficiency, Home Buyer Education	Site & Water, Energy Efficiency, Indoor Air Quality, Material Selection
Use of Verifiers	Independent Optional credit: 2 and 3 stars Required: 4 and 5 star levels	The MN GreenStar program uses raters to help verify the certification process.	Requires verification at the pre-sheetrock and final inspection phase.	5% random verified
Fees	Member: $50 (per unit) Developer (Built Green and MBA Member): $10 Developer (Built Green Member): $50	$100-$200 per project plus $0.10 per sq. ft. and $350 for training	Approximately 3% more than a typical home.	Built Green & MBA Member: $50; Built Green Member Only; $150 (per unit)

Table adapted from Dovetail article

Table 1.3: Side-By-Side Comparison of Green Building Programs 3

	GHBA- GBI	St. Louis -GBI
Full Program Name	Greater Houston Builders Association GBI	GBI St. Louis Program
Coverage Area	Houston Area	St. Louis
Year of Origin	2005	2006
Certification Levels	Pass/Fail	Bronze, Silver, Gold
Prerequisites	Must meet 23 of the 25 prerequisites. Chosen out of each category.	**Doesn't appear to have any
Environmental Categories	Site Development; Materials; Energy; Health; Water; Operations, Maintenance, and Homeowner Education	Lot Design, Preparation, and Development, Resource Efficiency, Energy Efficiency, Water Efficiency, Indoor Environmental Quality, Operation, Maintenance, and Owner Education, Global Impact
Use of Verifiers	Third party verification for Energy Star requirement.	Third Party Verifier: Laclede Glass
Fees		$125 application fee

Table adapted from Dovetail article

**Uses NAHB Model Green Building Guidelines

CHAPTER TWO

A STUDY COMPARING RESIDENTIAL GREEN BUILDING PROGRAMS

Introduction:

Residential green building programs have been formed and implemented within several US regions. They vary in their approaches to policy, the origin of the program, their mission, and sometimes their goals. However they all certify green homes. These homes use less power, consume less water, and draw upon fewer natural resources, and they provide a healthier living environment for the people residing in them. The success of residential green building programs within a city can be evaluated and compared to the overall success of sustainability within the city to see if the two forms of sustainability promotion are related. This paper will first introduce a study that evaluated the sustainability practices of 49 US cities. The researchers ranked these cities based on their performance on a comprehensive sustainability index ranging from high performance to low performance. The researchers then investigated the attitudes, beliefs, values and political cultures existing within the cities studied. After addressing the principal findings of this study, this paper will assess the degree of success attained by residential green building programs within some of the cities that were included within the first study.

Background:

The original forces behind green building programs are quite typically progressive municipalities, environmental organizations, or homebuilders associations. Sometimes a combination of two or more of these groups comes together for the purposes of forming a green building program. These organizations are generally run by an inclusive board of

directors, and often include certification programs for new-single family homes, multi-family buildings, commercial buildings, and remodeling. They typically assess homes based on their performance in the areas of energy efficiency, water efficiency, use of materials and resources, indoor air quality, site selection and planning, and homeowner education.

Cultural Sources of Variations in US Urban Sustainability Attributes:

In their paper entitled, "Cultural Sources of Variations in US Urban Sustainability Attributes," the authors William Budd, John Pierce, Nicholas Lovrich and Barbara Chamberlain from Washington State University's Division of Governmental Studies and Services rate U.S. cites based upon their level of sustainability. Their paper sought to link political culture to sustainability promotion, and to identify those aspects of local political culture that either facilitate or impede progress toward the adoption of pro-sustainability policies and planning processes.

The data on aspects of political culture was donated to the Division of Governmental Studies at Washington State University by the Leigh Stowell and Company Inc. (Moon et al.). The study used Stowell survey data collected in 1999, 2000, and 2001 (Budd et al., 6). The data include "a series of multi-item attitudinal measures that enable media advice to be tailored to local cultures. The surveys seek to tap into lifestyles that distinguish distinctive ways of life," (Moon et al., p.196). The survey includes a section of "psychographics" – namely, "42 questions (that) tap the variables of social trust, self-esteem, and liberalism-dimensions of social life that can be presumed to be core elements of local political culture," (Moon et al., p.196).

The authors researched the cities within the Stowell data and ranked them in the resulting "sustainability index" based on the categories of: public health (centers for disease control data), environmental quality (EPA data), economic vitality (census data), countering urban sprawl (census data and information on traffic delays), and planning and policy supporting sustainability ("city websites, comprehensive plans, and related documents") (Budd et al., p. 4). The resulting "sustainability index," shown in Figure 2.1., is described as a "list of 49 US cities included in the study; ranked by sustainability index (maximum score 5, minimum 0)," (Budd et al., p. 10).

Figure 2.1 Budd et al.'s 2008: Sustainability Index

Index Ranking	City	Score		Index Ranking	City	Score
1	**San Francisco**	**4.332**		26	Columbus	2.247
2	**Seattle**	**3.913**		27	Philadelphia	2.157
3	**Salinas**	**3.850**		28	Pittsburgh	2.156
4	**Minneapolis**	**3.396**		29	Tulsa	2.048
5	**San Luis Obispo**	**3.395**		30	Charlotte	2.039
6	Reno	3.240		31	Dallas	2.011
7	San Diego	3.235		32	Atlanta	1.981
8	Des Moines	3.061		33	Greensboro	1.951
9	Boston	2.974		34	Sacramento	1.949
10	Colorado Springs	2.931		35	Kalamazoo	1.929
11	Denver	2.825		36	Palm Springs	1.870
12	Albuquerque	2.817		37	West Palm Beach	1.776
13	Rochester	2.649		38	Nashville	1.751
14	Salt Lake City	2.642		39	Louisville	1.746
15	Spokane	2.637		40	Dayton	1.691
16	Providence	2.519		41	Virginia Beach	1.673
17	Las Vegas	2.512		42	Knoxville	1.650
18	Jacksonville	2.439		43	Miami	1.635
19	Hartford	2.436		44	Cincinnati	1.624
20	Kansas City	2.426		**45**	**Long Beach (CA)**	**1.611**
21	Mesa	2.395		**46**	**Baltimore**	**1.448**
22	Omaha	2.315		**47**	**Wilmington (DE)**	**1.398**
23	Oklahoma City	2.315		**48**	**Saint Louis**	**1.328**
24	Chicago	2.272		**49**	**Houston**	**1.313**
25	Cleveland	2.270				

After ranking the cities within the Stowell dataset archive for which data would be found on each dimension of sustainability on the sustainability index (a continuum from highest to lowest sustainability performance) the authors used the Stowell psychographics to determine the attitudes, beliefs and values that are representative of the cites at the top and at the bottom of the rank ordered index. Danial Elazar's historical legacy cultures, Robert Putnam's social capital concept, and Richard Florida's creative class concept were the major elements of local political culture that were used to assess

what types of political culture were exhibited within cities scoring at the top and the bottom of the sustainability index.

The paper set forth empirical evidence that Richard Florida's, "innovation index derived from the creative culture exhibits no significant correlations with the sustainability measures, (Budd et al., p.9). However, the other two political culture dimensions did exhibit such a correlation. "Our analysis suggests that within the US the most progress made to-date has come in cities where social capital resources have been mobilized to promote collective action directed toward sustainability, and where a moralistic political culture heritage serves as an important factor of progress toward this goal…" (Budd et al., p.9).

The premise of social capital has been thoroughly studied by Robert Putnam of the Kennedy School of Government at Harvard University. His book Bowling Alone discusses his theory that people have become less and less interested in community or social activities, and they have more isolated and engaged in individual as opposed to group activities or entertainment (2000). Putnam defines social capital as "social networks and the associated forms of reciprocity," (Putnam, 2000, p.21). "Your extended family… your Sunday school class, the regulars who play poker on your commuter train, your college roommates, the civic organizations to which you belong, the Internet chat group in which you participate, and the network of professional acquaintances recorded in your address book," are all examples given of social capital (Putnam, 2000, p.21). "The touchstone of social capital is the principle of generalized reciprocity," (Putnam, 2000, p.135). In other words, do you trust others to do unto you as you would do unto others?

Danial Elazar's moralistic political culture is characterized by the ideal of community attachment. "Politics, to this political culture, is considered one of the great human activities: the search for the good society" (Elazar, 1994, p. 232). The moralistic political culture believes in "utilizing communal (preferably nongovernmental, but governmental if necessary) power to intervene in the sphere of "private" activities when it is considered necessary to do so for the public good or the well-being of the community" (Elazar, 1994, p. 233). "The moralistic political culture is not committed to either change or the status quo per se but, rather, will accept either depending upon the morally defined ends to be gained" (Elazar, 1994, p. 234).

Hypothesis:

Given the sustainability index and political culture data (Budd et al., and Stowell data), an analysis can be done on the facilitators and inhibitors of success of residential green building programs compared with the sustainability index scores. By calculating the percentage of certified green homes within a given county this paper will examine the relationship between sustainable cites (within the sustainability analysis) and the success of residential green building programs. The hypothesis of this paper is that the cities that scored well within the sustainability index (Budd et al.) will have more residential green building projects (per new home start) than cities that had lower sustainability index scores. If this is the case, such findings would suggest that green residential building rates are responsive to the same socio-cultural dynamics as those which lead to the adoption of governmental policies and actions which promote environmental sustainability.

Methodology:

To understand the scope of residential green building programs within the cities scored on the sustainability index, a list of residential green building programs within those cities was compiled. Initially NAHB was contacted to secure such information. The NAHB asserts with confidence that their builders build eighty percent of the homes within the United States ("Our Organization," 2009), and several of the green building programs were organized and managed under home building associations that are indeed members of the NAHB. The NAHB staff directed our attention to their website, where a list of green building programs that worked in concert with the association was compiled (www.nahbgreen.org). The NAHB's website listing included some of the home building associations that were included within the final study; the rest of the programs noted in this study were found through search engines or were identified by contacting local homebuilders associations.

Once a list of residential green building programs operating within cities on the sustainability index was created, people managing those programs were contacted (via email and telephone) and information was collected on the number of homes that were certified in the period 2006-2008 by the respective programs. LEED for Homes data were collected via the USGBC website. Census data were collected for new home starts per county for the city involved taken from the sustainability index ("Building Permits," 2009).

The definitions of cities and their boundaries differ somewhat across the states within the U.S., and it has been noted quite correctly "the larger context in which cities exist can be quite varied from city to city," (Portney, 2003, p. 24). Also, sometimes the

growth that supports the municipality occurs outside the city limits. “Cities sometimes find themselves embedded in a metropolitan area dominated by sprawling residential and commercial development that affects the quality of their environment,” (Portney, 2003, p. 25). For these reasons data were collected on the **county level** instead of by municipality to account for these problematic differences across cities.

The number of single-family homes that were certified by a residential green building program within each county (between 2006-2008) was then divided by the census data’s new home starts to determine the percentage of certified homes within the area for study period. The data was compiled and are displayed on Table 2.1.

Findings

Table 2.1: Study Findings

City	Sustainability Index Ranking	County	Green Building Program	Year Certification Began	Number certified homes/ new home starts
San Francisco	1	San Francisco County	CA Green Builder, Build it Green: Green Point Rated	2005, 2003	5.8%
Seattle	2	King County	Built Green Washington	1999	33.5%
Salinas	3	Monterey County	CA Green Builder, Build it Green: Green Point Rated	2005, 2003	0.3%
Minneapolis	4	Hennepin County	MNGreenStar	2008	0.1%
San Luis Obispo	5	San Louis Obispo County	CA Green Builder, Build it Green: Green Point Rated	2005, 2003	0.6%
Long Beach (CA)	45	Los Angeles County	CA Green Builder, Build it Green: Green Point Rated	2005, 2003	0.7%
Baltimore	46	Baltimore County	---	---	0.1%
Wilmington (DE)	47	New Castle County	---	---	0.0%
Saint Louis	48	Saint Louis County	GBI: Saint Louis	2006	1.2%
Houston	49	Harris County	GBI: Greater Houston Builders Association	2005	0.0% **

*LEED for Homes is active within the entire US.
**Missing information from Greater Houston Builders Association

There is evidence of wide variation in the number of certified homes per number of new home starts within the top five and bottom five cities on the sustainability index. King County, Washington has the highest portion of its new homes certified with 33.5% percent. In second place was San Francisco with 5.8% percent.

None of the bottom five cities within the sustainability index had residential green building programs that had originated within the city. Statewide programs within California covered Long Beach. Saint Louis and Houston had programs that were set up by national programs. Out of the top five cities on the sustainability index, two had

programs that originated within the area in question. Build it Green: Green Point Rated originated within the Bay area ("History," 2009). The Built Green Washington program was created by the Master Builders Association of King and Snohomish Counties ("Welcome to the Seattle Area's Built Green Website," 2009). Statewide programs cover the other three programs within the top five.

Second Hypothesis:

Looking at the success of the Built Green Washington within King Counties, it is important to note that Built Green Washington was the only program that was studied that was over a decade old. This could have been a contributor to the success of the program. Understanding that two other cities within the index had established residential green building programs, a second hypothesis was formed. The second hypothesis of this paper is that residential green building programs will be more successful where programs are long-established (more than a decade old).

Methodology:

Built Green Colorado and EarthCraft House were contacted (via email and telephone) and information was collected on the number of homes certified between 2006 and 2008. Denver and Atlanta are interesting cities in which to define the encompassing county. Atlanta is a city that is plagued by sprawl, and made up of several counties. The counties of DeKalb, Fulton and Cobb were suggested by EarthCraft House to represent Metropolitan Atlanta, Georgia.

Denver County was established to encompass the entire city of Denver in 1902 ("History," denvergov.org). Since then the city has grown substantially. For the purpose of this paper we have chosen to add the counties of Jefferson, Adams, and Arapahoe to represent the counties in which the City of Denver lies.

Findings:

Table 2.2: Second Hypothesis Findings

City	Sustainability Index Ranking	County	Green Building Program	Year Certification Began	Number certified homes/ new home starts
Seattle	2	King County	Built Green Washington	1999	33.5%
Denver	11	Denver, Jefferson, Adams, and Arapahoe Counties	Built Green Colorado	1995	12.9%
Atlanta	32	Fulton, DeKalb, and Cobb Counties	EarthCraft House	1999	2.8%

*LEED for Homes is active within the entire US.

The second phase of research supported both the hypotheses. All three cities had a higher percentage of certified green homes compared to the younger programs within the study, excluding the highest-ranking city within the index San Francisco. The city of Denver, who ranked higher on the sustainability index, had a higher percentage of homes certified when compared to Atlanta. Atlanta ranks lower within the sustainability index.

Conclusion:

Figure 2.2: Bubble Plot; Study Findings

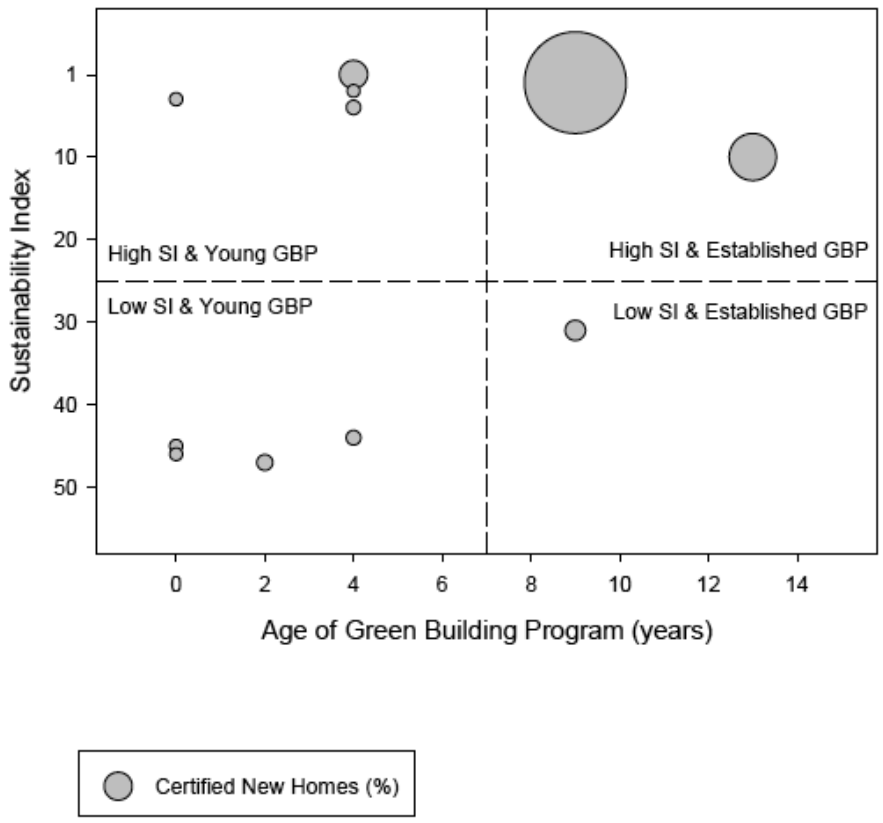

Figure 2.2: A plot depicting the percentage of certified new homes (bubble diameter) as a function of the Sustainability Index and green program age for the specific market studied. The bubble diameter is scaled to the percentage of certified new home starts using a non-linear transformation that exaggerated the size of small markets.

A non-linear transformation was employed in scaling the bubble diameter to the percentage of certified new home starts in Figure 2.2. Had the data been presented to scale, the data point for Seattle, WA would nearly mask the entirety of the graph. Markers also were used to represent cities within the study whose data point would otherwise be undetectable.

Figure 2.2 shows that the cities that had the most successful residential green building programs scored high on the sustainability index, and had programs over a decade old. King County (Seattle) Washington, represented by the largest circle on the bubble plot, had the highest percentage of their homes certified within the sustainability index, and all of the cities low on the sustainability index only a small fraction of new homes falling under the guidance of a green building program, and are represented within the lower left-hand corner of the bubble plot.

One of the conclusions that the (Budd et al.) paper found was that, "environmental and economic dimensions appear to be central elements of urban sustainability efforts." My next paper will discuss some of the environmental policies and planning that have been the focus of Seattle's sustainability effort, and compare it with efforts that have been taken within the top five and bottom five cities on the sustainability index.

CHAPTER THREE

A FOCUS ON SEATTLE, WASHINGTON

Introduction/Hypothesis:

Within the US there is increasing variation on what avenues of action cities have pursued in the name of sustainability. Seattle, Washington has a Comprehensive Plan, and a policy entitled Sustainable Seattle, and the city government has been heavily researching and implementing policies on sustainable development for quite some time. In contrast, St. Louis Missouri has not updated its Comprehensive Plan since 1947. This contrast in sustainable development policy could account for at least some of the difference in level of success of the residential green building programs in these two cities.

Research in the previous paper found that among cities listed on the sustainability index (Budd et al., 2008) King County (home of Seattle, Washington) had the most certified green homes when compared to the number of new home starts. The hypothesis of this paper is that Seattle has established policies and plans that encourage residential green building. This paper will first characterize policies that would encourage residential green building. Next the paper will address policies that affect Seattle. Seattle lies within King County, and the state of Washington, and as a result is heavily affected by policies established by those political jurisdictions. Finally, the paper will be concluded by a discussion of what actions other cities within the sustainability index have taken to desired address green building outcomes.

Policies That Encourage Green Building:

A few analyses of what can be done to encourage residential green building are present in the literature. For example, the American Institute of Architects (AIA) recently released a commissioned study titled "Local Leaders in Sustainability: Green Incentives," (2008) which provides some suggestions along these lines. Also McGraw Hill Construction and the NAHB compiled a similar report two years prior entitled "Residential Green Building: Smart Market Report," (2006). These two reports discuss some of the reasons why progressive and responsible builders choose to build green projects.

The AIA reported that residential green building has become increasingly popular in recent years, and that a robust demand for this type of building framework is in strong evidence nationwide. The researchers compiling the report collected a great deal of publicly available data from municipalities, and in addition conducted roundtable discussions with people within the building industry to document what incentives and inducements would encourage the builders to build green.

> *An analysis of the research combined with the Developers Roundtable discussion indicated that the most attractive incentives are:*
>
> - ***Tax Incentives****- temporarily reduce taxes for specific levels of green measures and certification;*
> - ***Density/Floor Area Ratio Bonuses****- implement height bonuses, floor/area ratio bonuses, reductions in landscaping requirements, and count green roof space as landscaping/open space in return for achieving levels of green building rating; and*
> - ***Expedited Permitting****- streamline the permitting process for building, plan, and site permits on projects that achieve a certain level of sustainability ("Local Leaders In Sustainability: Green Incentives," 2008).*

The McGraw Hill Construction/NAHB partners' researchers surveyed a cross-section of homebuilders on their perceptions of green building, and compiled those findings with other data and concluded that: "The most important motivators for builders when considering building green homes are "doing the right thing" and "lowering lifecycle costs," ("Residential Green Building: Smart Market Report," 2006). In addition to those two things, builders also cited the following considerations as leading to an increased likelihood of building a residential green home:

Most frequently citied triggers to increased residential green building:

- *Energy cost increases*
- *Consumer demand*
- *Superior performance*

Most frequently citied obstacles to increased residential green building:

- *Higher perceived first costs*
- *Consumer willingness to pay*
- *Lack of consumer education on green building ("Residential Green Building: Smart Market Report," 2006).*

If one of the largest cited obstacles for green building is cost ("Residential Green Building: Smart Market Report," 2006), it begs the question: Is building a green building more expensive? A 2003 study concluded, "a minimal upfront investment of about two percent of construction costs typically yields life cycle savings of over ten times the initial investment," (Kats, pg.v). The same study found that,
"the financial benefits of green buildings include lower energy, waste disposal, and water costs, lower environmental and emissions costs, lower operations and maintenance cost, and savings from increased productivity and health," (2003, Kats, pg.v). To tackle "higher perceived first costs," a city attempting to promote green building should

promote public education and awareness that specifically focuses on affordability and cost.

In conclusion, builders tend to find that a city that seeks to encourage residential green building would wisely make use of public policies such as: tax incentives, construction bonuses, streamlined permitting, and builder and active homeowner education. These cities would seek to include people that had a strong moral compass for "doing the right thing" in their efforts to promote public education (especially on affordability), and might be situated in a region with high-energy costs and able to show a substantial long-term benefit from building green.

Findings:

Seattle, Washington is characterized by mostly liberal, highly caffeinated, fairly environmentally friendly people who typically are supportive of Starbucks, Boeing, Microsoft, Weyerhaeuser and other major corporations that have developed within the city or Puget Sound region. That attitude that combines liberal environmental ideologies with pro-development and business-friendly views has helped Seattle become a focal point for sustainable development.

The City of Seattle is very serious about its environmental policies. Within the city's Comprehensive Plan the following is stated:

"when environmental goals compete with other City goals, such as those related to economic development, the City is committed to giving just consideration to the environmental goals to protect the functions that natural systems can perform and to prevent harmful effects on human health," (11.3, 2005, amended 2009).

The city's leaders have worked hard to incorporate green building practices as part of their environmental goals. The Seattle Department of Planning and Development's stated

mission is to "make green building standard practice in Seattle through education, technical assistance and incentives," ("Seattle Department of Planning and Development," 2009). "We recognize that making green building standard practice is an evolutionary process that will consist of changes at many levels over time," ("Seattle Department of Planning and Development, " 2009).

Helping the City of Seattle educate the public on green building is a non-profit organization named Sustainable Seattle. The mission of this organization includes working towards an "integrated vision of urban sustainability by measuring progress, building diverse coalitions, and undertaking key initiates," ("Sustainable Seattle," 2009). "We provide education to leaders, residents, planners, developers and others involved in smart growth, green building and place making efforts, including transportation, public spaces, open spaces, civic dialogue, urban planning and design, community building, waste, energy, and food security" ("Sustainable Seattle," 2009).

The City of Seattle has used a combination of a regulatory approach, tax incentives, grants, loans, expedited permitting, construction benefits, and rebates on energy bills to push for green building. Mandated in 1999, any new City building has to receive the LEED Silver rating before it can be constructed. This has lead to the construction of a total of fifteen LEED-certified city buildings as of September 2009 ("Department of Planning and Development"). "Projects achieving a LEED Silver rating or higher that contribute to affordable housing and other public amenities may receive greater heights and/or floor area for commercial and residential buildings," ("Local Leaders In Sustainability," 2008). Expedited permitting for green buildings include

"priority intake appointments, and 50% faster initial plan review with no extra permit fee," ("Department of Planning and Development," 2009).

The process of public education on federal tax incentives is promoted through City websites and a variety of informational programs. The City of Seattle gives out grants and loans for green building through their Homewise program, and Puget Sound Energy gives rebates for some energy-saving improvements done to the home ("Department of Planning and Development," 2009).

As a result of these various activities, Seattle has a combination of high single-family certified green homes as well as multi-family and commercial certified green projects. As of September 2009, Seattle's Department of Planning and Development website stated that they had eighty-two LEED certified commercial and multi-family buildings, and fifty-three homes officially certified with the LEED for homes program (2009).

Noteworthy regulations and incentives exist on the King County level as well. In 2007 King County released its County Climate Plan, stating, "King County seeks to reduce greenhouse gas emissions and works to anticipate and adapt to projected climate change impacts, based on best available science," (2007 King County Climate Change Plan, pg.6). One of the goals of the plan was to "continue to reduce greenhouse gas emissions from its buildings and infrastructure investments through climate-friendly design, development, use and demolition," (2007 King County Climate Change Plan, pg. 68). King County mandates that any facility that receives county funding must achieve LEED certification and, must "strive to achieve LEED Gold rating," (2008 Green Building Program: Annual Report, pg.1). County-level incentives include free project

management, priority processing, and grants for certified projects built within unincorporated King County ("King County: Solid Waste Division," 2009).

The State of Washington has also passed legislation mandating that certain buildings achieve LEED certification, and mandating a study into green buildings. For example, Washington State Senate Bill 5509 (2005) mandates that public buildings within Washington State that receive state funding, and Schools in the state must achieve a minimum of LEED Silver rating for new buildings being proposed. ("Washington Votes. Org"). In a similar vein, House Bill 3120 "mandates a study of tax incentives to encourage construction of energy-efficient residential and commercial structures," (House Bill Report, 2008). The analysis underlying that bill found that "the following five approaches merit further consideration:"

1. *Sales Tax Remittance for Clean Technology Purchases*
2. *Sales Tax Refund for Non Residential New Construction*
3. *Public Utility Credit*
4. *Transferable Energy Tax Credit*
5. *Property Tax Based Incentives (Wilkerson, 2008).*

In cases where state laws have interfered with builders achieving credits on green building codes, the State of Washington has sided with green building interests. Previously it had been illegal to collect rainwater within the State of Washington, the reasons given were that the Washington streams, rivers, and lakes need rainwater to support aquatic life. However, many green building programs include credits for rainwater harvesting, including rain barrels and other storage of rainwater. On October 9th the Department of Ecology released a statement clarifying the regulations on residential rainwater collection. "The onsite storage and/or beneficial use of rooftop or guzzler

collected rainwater is not subject to the permit process of RCW 90.03," ("Water Resources Policy Regarding Water Collection of Rainwater for Beneficial Use," 2009)

Comparison with other cities on the Sustainability Index:

Three out of the top five cities within the sustainability index lie within the State of California. California has come up with a policy that surpasses the regulatory policies that have been implemented in the State of Washington. The State of California has released its own "California Green Building Standards Code," whose provisions will be Mandatory for all buildings within the state as of January 1, 2011. The code is similar to a pass/fail checklist. The code includes requirements within the categories of: planning and design, energy efficiency, water efficiency, material conservation, and indoor environmental quality.

San Francisco, California, which ranked number one on the Budd et al. sustainability index, has unique challenges and benefits alike for builders. The city's architecture has strong historical significance and is highly regulated. San Francisco has used green building certification as part of a plan to achieve its goals of "reducing the green house gas emissions in the City and County of San Francisco to 20 percent below the 1990 levels by the year 2012," (Press Releases, 2008). The new policy is even more regulatory than that of the State of California. As of January 2009 all residential projects within the San Francisco city limits must achieve 25 GreenPoints under the Build It Green: Green Point Rated program, As of January, 2010 50 points must be achieved, and January, 2011 75 points (San Francisco Building Inspection Commission Codes, 2007, p. 1). Green buildings that receive LEED certified Gold or equivalent within other green building

rating systems are given an expedited permitting process ("Directors Bulletin No. 2006-02," 2006).

Ranking number four on the Budd et al. sustainability index is Minneapolis, Minnesota. Hennepin County had only 0.1 percent of its new home starts certified green. Minneapolis has made substantial efforts towards sustainable development without including green building certification as a policy mandate. In 2008 the City:

- *Revised the zoning code to require bicycle parking for most developments.*
- *Made biking a more feasible option for moving around the city by increasing opportunities for people to use bikes with more new trails, the new Midtown Bike Center, and the launching of the Bike Walk Ambassador program.*
- *Awarded 25 climate change grants for a second year to support grassroots efforts motivating residents and businesses to take action to reduce global warming.*
- *Completed the City Hall and Courthouse building's 5,000-square-foot green roof with plantings as part of a waterproofing and stormwater management project. Plants will be irrigated with water from a 10,000 gallon cistern installed as part of the project. (Minneaplis Greenprint: 2009 Environmental Report, p.4).*

One reason green building certification may not be as popular in Minneapolis is because their regional green building program, Minnesota Green Star, did not officially begin rating buildings until 2008.

Cities within the bottom five on the sustainability index have shown slow growth towards encouraging residential green building. St. Louis, Missouri has not updated their Comprehensive Plan since 1947. They do, however, require new city buildings to be certified LEED Silver (Ordinance #67414). In 2008 Wilmington Delaware's Mayor released Executive order 2008-04 that outlined sustainability plans for the City. The City is interested in developing a green building program, and that they were pursuing LEED Silver for a new city building. There have been no more press releases on the

sustainability plan since this 2008 executive order. The City of Houston, Texas just opened their Green Building Resource Center. The center helps builders with green building strategies and resources ("Mayor's Office of Environmental Programming," 2009).

Baltimore, Maryland has made exceptional strides towards sustainable development since Mayor Sheila Dixon was elected to office in 2007. She started a Commission on Sustainability in 2008, and released their first Sustainability Plan in April of 2009. The plan includes the outline of the initial stages of development of a green building program for the area ("The Baltimore Sustainability Plan, 2009).

Conclusions:

Residential green building policies within the City of Seattle (including those created by King County and the State of Washington) encourage residential green building, and are more comprehensive than those of other cities listed among the 49 urban centers listed in the sustainability index. Seattle was the only city within the study that addressed regulatory measures, tax incentives, construction incentives, expedited permitting, green building education, grants and loans, and even green building research. Seattle also has the benefit of having a large non-profit assisting in the education of policy makers and other residents. Other municipalities and states either rely heavily on regulation, or have not been pursuing sustainable development as long as Seattle and are their policies are not as developed.

Market Implications:

The findings reported in this study suggests that within cities that have a history of sustainable policies, practices, and popular beliefs and attitudes residential green building programs will perform better than in cities with unfavorable attitudes and beliefs regarding mutual trust and civic engagement and toward sustainability. Cities that lack sustainable polices and practices are most likely to feature these socio-cultural characteristics. The findings of this study also suggest that cities that have a focus on educating the public on the affordability of green building would experience a larger percentage of certified green homes. One could expect that a program will do better and better once it has had time to establish itself within the community and demonstrate its value for both individual families and their respective communities.

CHAPTER FOUR

CONCLUSIONS

This thesis has found that residential green building programs have a variety of differing missions and goals, however they all tend to measure similar categories of concern namely, energy efficiency, water efficiency, wise use of materials and resources, site selection and planning, and homeowner's education. It also found that King County, Washington (home of Seattle, Washington) has had the most success of any county within the study in certifying residential green homes. This thesis found that policies within Seattle promoted residential green building, indicating that the success of green building problems is likely related at least in part to providing attitudes toward civic engagement and sustainability, the age of the program within the region, and the existence of specific public policies and plans that encourage residential green building.

So, what promotes Residential Green Building? The article "Cultural Sources of Variations in US Urban Sustainability Attributes" found that attitudes that promote sustainable development are found within cities "where social capital resources have been mobilized to promote collective action directed toward sustainability, and where a moralistic political culture heritage serves as an important factor of progress toward this goal" (Budd et al., p.9). This thesis found that the longevity of the green building program has also made a difference in the accomplishment of green building goals. Where residential green building programs are more than a decade old, and within those cities that have in general had been more successful on sustainability issues (when compared to other cities within the study), they tended to be more successful. Policies that encourage residential green building were found to be ones that addressed regulatory

measures, tax incentives, construction incentives, expedited permitting, green building education, grants and loans, and green building research. All of those conditions exist within Seattle, Washington, and are reinforced by King County and State of Washington programs and policies.

Future Research

As noted previously, residential green building is a topic area where we can expect a good deal of research in the future. The staff of one respected residential green building program noted in this regard:

> *Green building is an ever evolving subject of study and revelation. New insights into building performance, material impact and durability, better life cycle analysis tools, and a better understanding of the world around us as it changes are constantly being reviewed and incorporated into the MN GreenStar program. Our intent is that this program and these documents continue to grow and evolve over the coming years with input from those who are using the program. (MN GreenStar Guide, p. 5)*

This field will benefit from future research within technologies that assist with green building strategies, and how those technologies will be incorporated within green building programs. Further research into innovations within sustainable design should be conducted, for instance green roof technologies. Also, with the relative infancy of national green building programs it is necessary to continue to research the local effects of these national programs. These programs should be addressing local climates, and how they vary within the US.

Future research may also address economic conditions, and how higher perceived first costs within a period of economic instability affect the likelihood of choosing green building certification. Also, how education and outreach could be used to counter these perceptions.

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