QUANTIFICATION OF ENERGY STAR® QUALIFICATION FOR NEW HOMES: AN INVESTIGATION OF MARKET IMPACTS

A Thesis
by
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Abstract

QUANTIFICATION OF ENERGY STAR® QUALIFICATION FOR NEW HOMES: AN INVESTIGATION OF MARKET IMPACTS

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Buildings represent 41% of the annual energy consumption in the United States, more than either manufacturing or transportation (U.S. Energy Information Administration [USEIA], 2009). As society becomes increasingly energy conscious, individuals are seeking new ways to reduce residential energy usage. Third-party verified energy efficiency programs aimed at making buildings more efficient are gaining popularity in residential construction and offer many benefits to home builders and home buyers alike. ENERGY STAR® is a popular third-party verified construction program that can reduce home energy consumption by a minimum of 15% compared to homes built in accordance with the 2004 International Residential Building Code. Furthermore, these homes can include additional features that make them 20 to 30% more efficient than code-built homes (*Qualified New Homes*, n.d.).

Obstacles to widespread implementation of the ENERGY STAR program include the added costs involved in building an ENERGY STAR qualified home and home builder reservations concerning financial return on investment. This study first examined all ENERGY STAR qualified home sales and compared their market performance to non-qualified homes within a ten-county region of central North Carolina as well as within

smaller geographic divisions of the same region. Additionally, a more controlled investigation of sampled homes that was designed to compare the most similar qualified and non-qualified homes from five counties within the region was conducted. Findings were generally similar when examining the entire population of home sales in the region as well as the more tightly controlled sampled investigation. It was found that ENERGY STAR Homes sold faster (i.e., fewer days on the market) and sold for higher prices than non-qualified homes. Additionally, they sold for a greater percentage of the listing price and earned a higher price per square foot than non-qualified homes. These findings provide much-needed evidence that there is a market advantage for ENERGY STAR qualified homes that can achieve a positive rate of return on ENERGY STAR qualification investments.

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TABLE OF CONTENTS

Quantification of ENERGY STAR® Qualification for New Homes: An Investigation of Market Impacts

CHAPTER 1: INTRODUCTION

Energy efficiency has recently become a topic of interest in the United States due to the enactment of several government-backed and energy industry-related green initiatives. The American Recovery and Reinvestment Act (ARRA) of 2009, the Energy Policy Act of 2005, and the Energy Independence and Security Act of 2007 are ongoing efforts to change the way energy is utilized on a national scale. The United States leads the world in energy consumption, and demand for energy will only increase in the future. As a result, these new laws encourage alternative and more effective energy management practices. To accomplish this goal, both the number of tax incentives and the amount of direct federal spending on energy efficiency have reached an all-time high. Increasing efficiency in the way energy is utilized across sectors of the country's infrastructure is viewed by many as the most practical, cost effective, and directly implementable method for addressing the country's energy needs (Dixon, McGowan, Onysko, & Sheer, 2010).

In the US, residential and commercial buildings account for roughly 41% of the annual energy consumption, including electricity and other energy sources like natural gas and fuel oil. This figure constitutes more energy usage than in any other sector, including transportation and manufacturing, which contribute 29% and 30% of consumption,

respectively. Residential buildings are responsible for 22% of US energy consumption alone (United States Energy Information Administration [USEIA], 2009). Operating commercial and residential buildings represents an even greater proportion of the country's electricity usage, consuming 75% of the electricity produced (*Use of Electricity*, 2010). In the residential sector, building energy is primarily utilized for space conditioning (heating and cooling), followed by water heating and lighting (USEIA, 2005). It is clear from these statistics that buildings in the US are responsible for consuming a majority of the country's energy resources. Efficiency improvements must be made to buildings so that the nation can manage its available energy resources more effectively as demand for these resources increases in the future.

Statement of the Problem

Residential buildings in the US are responsible for a disproportional amount of the country's energy consumption. Many building energy efficiency certification programs, including ENERGY STAR®, have been created to combat this problem by reducing a home's energy consumption. ENERGY STAR qualification, like other certification programs, requires added up-front costs for home builders and home buyers, which unfortunately deter many from investing in efficient homes or which may place the home outside of their financial means. Compounding this problem, the lending and appraising industries often ignore the financial benefits associated with more efficient housing (Ball, 2011). Although changing the standard practices in these industries so that they do consider energy efficiency is vital, the process has been slow-moving despite strong evidence to support this ideology.

While it is true that some parallels exist between today's economic climate and the economic conditions present during many past studies investigating market valuation of energy efficient home features, new evidence gathered from recent homes sales is needed. Additionally, many past investigations occurred before the creation of today's building energy efficiency certifications. Compounding the need for more current evidence, published studies conducted after the creation of modern building energy efficiency certification programs have not considered the impact of ENERGY STAR qualified homes (or any other certification program) alone. Instead, the common practice has been to group all homes with any type of building certification together and to compare them against code-built homes. This procedure represents an unfair analysis because many building certification programs require a relatively larger financial investment beyond that of a code-built home and that financial inequity is expected to be reflected in the home's market performance. ENERGY STAR qualification, by comparison, represents a relatively smaller additional investment for the builder, typically around 0.5%-1.5% (depending on economies of scale) of the home's listed retail value, making a side-by-side comparison against a code-built home much more favorable. The present investigation seeks to add to the body of evidence concerning the added value energy efficiency can bring to a home, and, more specifically, to document the impact of ENERGY STAR Home certification by presenting evidence about the market advantages that home builders, real estate agents, and home buyers might capitalize on in today's economic climate through ENERGY STAR.

Purpose of the Study

The present investigation seeks to build upon the findings of prior studies that demonstrate benefits of energy efficient features and home certifications and to provide new information specific to the impact an ENERGY STAR qualification alone can add to the value of a new home beyond that of monthly utility savings. It has previously been demonstrated that ENERGY STAR Homes provide savings to owners on monthly utility bills (Jones & Vyas, 2008), but do these efficiency features translate into a willingness on the part of consumers to pay more? Additionally, do consumers seek out ENERGY STAR Homes in such a way that these homes spend less time on the market? Because the majority of home sales databases, including the Multiple Listing Service (MLS), do not provide information regarding home certifications such as ENERGY STAR, little or no data has been available to address these important questions. The present investigation, however, utilizes information obtained from the Triangle (North Carolina) MLS. The Triangle MLS has been an industry leader in providing information on energy-efficient certifications for homes since April 2009, making research in this area possible for the first time (*Triangle MLS Adds Green Fields*, 2009).

The process of changing appraisal standards and lending criteria is not one that will happen quickly. Although efforts are underway to accomplish this task, home builders need evidence that their investment in making their homes energy efficient is beneficial now. Likewise, the potential home buyer needs to know that paying more for an efficient home is a smart investment beyond monthly utility bill savings. Furthermore, both parties need evidence that energy efficiency is an investment they will likely recoup. To that end, the present investigation seeks to determine if homes that are ENERGY STAR qualified hold a

market advantage over similar code-built homes, giving home builders and home buyers security in efficiency investments. Additionally, the present investigation seeks to add to the body of evidence convincing lenders and appraisers of the advantages of energy-efficient housing in an effort to account for these benefits during loan origination and market valuation.

Research Hypothesis and Research Questions

The present investigation hypothesizes that ENERGY STAR qualification gives a home a competitive market advantage compared to a code-built home. Competitive market advantage has been operationally defined as a home selling for a higher sales price, selling for a greater percentage of the list price (i.e. better sale price to list price ratio), selling for a higher price per square foot, or spending less time on the market prior to sale. A home's value is important for home buyers and home builders alike, but it can be examined in several ways. The sale price is one method of determining a home's value, but it may be equally important for a builder to understand the ratio of actual sale price to the original list price as well as how much the home sold for on a per square foot basis. These ratios of sale price to list price and price per square foot help to indicate the potential room for profit or loss, and it is important for builders to know if an ENERGY STAR qualified home can reliably bring in more profit. Additionally, knowing how long a home will take on average to sell is important for the builder because there are substantial costs tied to holding a home while a buyer is found. The specific research questions formulated to document whether ENERGY STAR Homes have a market advantage include:

1.) Do ENERGY STAR qualified homes sell for higher prices compared to similar code-built homes?
2.) Do ENERGY STAR qualified homes sell for a greater percentage of their list price compared to similar code-built homes?
3.) Do ENERGY STAR qualified homes sell for a higher price per square foot compared to similar code-built homes?
4.) Do ENERGY STAR qualified homes sell faster (fewer days on the market) compared to similar code-built homes?

Overview of Research Methodology

The present study assessed the market impact of ENERGY STAR Homes by implementing two different methodologies (presented in Chapters 3 and 4). Part I of the methodology employed was that of a more traditional market overview similar to those conducted by Matthews (2009), Mosrie (2011), and Argeris (2010), all of which are discussed in Chapter 2. However, the current investigation's market overview differed from the prior studies by comparing only homes that are ENERGY STAR qualified (rather than combining all homes with any green certification) to homes with no green certifications. The current investigation's market overview is explained in greater detail in Chapter 3. Part II of the methodology employed a higher degree of home variability control and used a representative random sample to compare homes that were as similar as possible to one another, given real world constraints. This methodology was generally based upon the study by Griffin (2009), also described in Chapter 2. The methodological approach to Part II of this ENERGY STAR Homes study is elaborated upon in greater detail in Chapter 4. Examining

ENERGY STAR Homes in the manner discussed in Chapter 4 enabled near-experimental control over many factors that could potentially drive market performance differences between compared homes that cannot be specifically attributed to ENERGY STAR qualification, allowing for the highest fidelity comparison. Again, as in Part I of this study, only ENERGY STAR qualified homes were compared to non-qualified homes. Homes with other green building certifications or with two or more certifications (even if one certification was ENERGY STAR) were omitted from the investigation. This strategy prevented any additional investments tied to other certifications from confounding results pertaining to market performance.

Limitations of the Investigation

The present investigation was designed to provide evidence supporting the hypothesis that ENERGY STAR Homes have a competitive market advantage compared to similar code-built homes. To accomplish this task, a two part investigation was undertaken. Given the nature of this multidimensional investigation and its use of data representing actual home sales, a number of limitations must be acknowledged.

The results of Part I and Part II of the investigation should not be extrapolated beyond the area from which the information was obtained (the Triangle region of central North Carolina). The generalizability or external validity of the results of the study may be compromised due to the characteristics of the region from which the sample was drawn. Because real estate markets can vary dramatically from location to location and because this study only includes data drawn from a relatively small geographic area of North Carolina, it may be difficult to suggest that findings could equally apply to southern California or Alaska

as they would North Carolina or even outside the specific counties polled for this investigation. It should also be mentioned that a small geographic sampling area is a limitation encompassed by most investigations of this kind and for the most significant evidence to be uncovered a coordinated study sampling homes from around the entire nation should be undertaken.

Results produced by Part I of this investigation may be detrimentally impacted by inequities between ENERGY STAR and code-built homes. This potential limitation arises because only single-family, detached, new homes with either ENERGY STAR qualification or no green building certifications were compared. The homes were not matched on like dimensions and no control was offered to ensure that the comparison homes are the same (with the exception of ENERGY STAR qualification) as the ENERGY STAR Homes they were compared to. The data in this investigation simply represents a market recap of home sales data as recorded by the Triangle MLS. This could mean that differences found between ENERGY STAR Homes and their code-built counterparts could simple be arising because a large number of discrepancies exist between the two groups other than ENERGY STAR qualification. For example, if a difference in sale price between the two groups is found it could be due to ENERGY STAR qualification, or it could be due to another factor such as that ENERGY STAR Homes are built in areas where the property holds higher values. The code-built homes may be much more widespread, encompassing areas that hold low property values. Thus, the potential of confounding variables driving differences in market performance are not controlled for or accounted for in any fashion and may be largely responsible for any seen differences. Part II of this study represents a more tightly controlled investigation, where differences between groups were minimized so that more powerful

conclusions could be drawn. Despite this benefit of added control, it should be noted that full experimental control was not achieved in Part II of the study because real-world home data was used and random assignment of the ENERGY STAR qualification variable was impossible. This study represents a quasi-experimental design and therefore findings do not purport to imply causality, but are likely suggestive of causal relationships.

The data used in both Part I and Part II were limited to only those new construction homes listed on the Triangle MLS. MLS listings generally embody the vast majority of new residential real estate listings. However, it may be possible that homes not listed on the MLS (such as custom home sales, presales, or sales-by-owner) could alter the findings of this study. Unfortunately, there is no way that this data could have been captured for this study.

MLS records are most commonly created through data entered directly by real estate agents or other personnel within a real estate office. Because there are no strict guidelines or oversight to most MLS systems, input errors and errors of omission are possible. Furthermore, the green certifications data field was only recently introduced to the Triangle MLS database. It is therefore conceivable that some persons responsible for inputting the MLS data were unaware of the field's existence. Concurrently, these persons may have been unaware that a particular home had any green certification, possibly due to a lapse of communication by the home builder or other involved party.

Part II of the study may additionally contain a time/context confound surrounding the fact that real world data, not experimental data, were utilized. It may not always be possible to find acceptably similar homes that were sold around similar timeframes. In the effort to find similar homes sold in similar timeframes, the likeness between the comparison homes' physical features took precedence over when the homes sold. Thus, the time of sale may have

varied by as much as eighteen months, and therefore the sale prices may have been affected by differences in the economic climate surrounding the real estate market or other time-related differences. Contributing to this problem was the fact that each ENERGY STAR Home in Part II of the study was compared to three code-built homes, making the availability of acceptable comparison properties that much more difficult. Despite this difficulty, having three comparison properties captured a much more accurate representation of properties approximating the subject property, allowing for a more robust comparison. It should be noted that only one comparable home in the study sold as far as eighteen months from its subject property and one other sold fifteen months prior to its subject property. However, 75% of the comparable homes in the study sold within approximately six months or less of their subject property, which is considered by industry standard as an acceptable timeframe for comparison. One way to overcome this limitation would be to replicate this investigation periodically over the next few years to see if any lasting trends emerge. Alternatively, the findings could be replicated after the economy has become reasonably stabilized.

The results produced by Part II of the current investigation may have been impacted by inequities between ENERGY STAR and code-built homes that were not accurately accounted for or that were simply ignored during the appraisal process. Measures mentioned later in Chapter 4 in the section titled “Appraisal properties data set” were taken to address this potential limitation. Standard appraisal industry practice, which historically has ignored the value of energy-efficient home features (Ball, 2011), is the most common and best-established and regulated method for accounting for differences between properties. However, there still remain differences between homes that are not accounted for during the appraisal process. For example, consider two homes that sit on two similar pieces of property

with the same size and similar location. Now imagine one home's land has a higher tax value and a higher initial cost. This higher land cost was most likely recovered by the builder during the sale of the home, pushing its sale price up, but may be ignored in the appraisal process if the two properties were acceptably similar in size and location. In this case, the appraisal process would consider them equal and not make a financial adjustment to either property despite one having more cost tied to the land. Small inequities like this and other similar instances could add up to having a significant impact on trying to best equate properties for comparison. However, this problem is mitigated by having three comparison properties, since any inequities found in one home are minimized during the aggregate composite date procedure discussed in the section titled "Data Analysis Procedures."

Finally, in Part II of this study the adjustments that were made to ensure equality among the comparison and subject homes may not have best represented the true financial differences associated with a particular home's features. For instance, if the subject home had particle board kitchen cabinets and its comparison property had much higher grade, handmade, solid wood cabinets, an adjustment was made to account for the difference. However, this adjustment may not have fully covered the financial difference between the two types of cabinets, resulting in an inequity not properly captured. Despite these potential drawbacks, the current investigation utilized standard appraisal industry practices combined with a number of researcher-specified requirements aimed at making the processes as accurate as possible. These additional appraisal guidelines are discussed in Chapter 4 in the section titled "Appraisal properties data set."

Significance of the Investigation

The results of the present investigation provide home construction industry professionals with powerful evidence about the market advantages of building to ENERGY STAR qualification standards. Furthermore, the results offer much-needed evidence for the lending and appraising standard industry practices with regard to market impact that up until now have given little consideration to the energy efficiency of residential buildings (Ball, 2011). Additionally, there has been no prior study identified that links ENERGY STAR qualification alone with potential added market value. Previous investigations like Griffin's (2009) study and the market overview analyses conducted by Argeris (2010), Matthews (2009), and Mosrie (2011) examined homes with any type of green certification, or included homes that had multiple certifications. Many other green certifications (e.g., LEED, Passivhaus, and so on) can add substantial additional financial investment and may require specialized equipment installations (e.g., alternative energy systems) compared to ENERGY STAR qualification. Because of this added investment it would logically follow that these homes would sell for more compared to their code-built counterparts. In other words, it makes sense that homes that cost significantly more to build would sell for more. ENERGY STAR qualification alone, representing a relatively modest investment, is a program better suited for widespread implementation and also represents a more appropriate certification program for comparison with code-built homes than do the more costly and more stringent certifications like LEED. Demonstrating the financial viability of investing in this small additional building cost to lenders, appraisers, home builders, and home buyers alike represents a critical step in reducing home energy use and increasing the market penetration

of green certified buildings.

CHAPTER 2: REVIEW OF LITERATURE

Increasing building energy efficiency is an important step in reducing the country's energy consumption. Residential buildings are especially important to consider because they consume over 22% of the total energy produced from all sources in the United States (USEIA, 2009). Historically, however, this level of residential energy consumption is not new. Residential energy use has always represented a significant portion of overall energy consumption. In the past, improvements in home energy efficiency have traditionally followed increases in energy costs (Nevin, 2010). Today, with energy costs rising again, a renewed focus has been placed on energy efficiency improvements and multiple building certification programs have been created to help facilitate these improvements.

Building Certification Programs and ENERGY STAR®

In response to the need to make buildings more efficient, a growing number of organizations have created building certification programs. These programs focus on many aspects of construction with an emphasis on energy efficiency, use of sustainable building materials, improved indoor air quality, minimization of potable water consumption, use of alternative energy, and appropriate site selection and management, to name a few. While these certification programs offer numerous advantages for the socially and environmentally minded home buyer, they also encompass one major drawback. The vast majority of these programs require significant additional financial investment during the construction process. This additional investment can quickly place energy efficient housing outside the means of

the average home buyer. It also means many certified homes should sell for more than non-certified homes of similar size, location, and amenities, provided that they do not encompass any of the features required for certification. This implication can be problematic when conducting market analyses to determine potential advantages tied to certifications alone. A home that costs more to build should also cost more to buy; thus, homes achieving more expensive certifications would be expected to outperform non-certified homes on the market. However, the present investigation has identified one energy efficiency certification, ENERGY STAR qualification that does not require significant additional financial investment, making comparisons to standard code-built homes much more appropriate.

ENERGY STAR is a voluntary labeling program operated jointly by the US Environmental Protection Agency and the US Department of Energy. It was created in 1992 in an effort to raise awareness of, and to reduce, air pollution and climate change (Banerjee & Solomon, 2003). Its purpose is to promote products that meet specified energy efficiency requirements and performance criteria with the use of the ENERGY STAR label. While the ENERGY STAR label is readily recognized on many household appliances and electronics, it is less well-known as a home-building certification program. ENERGY STAR for homes, first implemented in 1996, constitutes a comprehensive approach focused on increasing a building's efficiency. More advanced applications of ENERGY STAR also focus on indoor air quality and domestic water use. To qualify as an ENERGY STAR Home the home must reduce energy consumption by a minimum of 15% compared to homes built in accordance with the 2004 International Residential Building Code. ENERGY STAR Homes may also include additional features that can make them 20% to 30% more efficient than standard code-built homes (*Qualified New Homes*, n.d.).

ENERGY STAR Homes have been demonstrated to be more efficient than standard code-built homes. A case study conducted in Gainesville, Florida by Jones and Vyas (2008) found that over two separate calendar years ENERGY STAR buildings were more efficient than their code-built counterparts. Furthermore, this efficiency increase brought with it appreciable savings on monthly utility bills due to reduced energy consumption. In addition to lowering monthly bills, this meant the average homeowner from the study could afford a larger mortgage payment (Jones & Vyas, 2008). The implications of this case study suggest that prospective home buyers will be able to spend more on their new homes and at the same time save on their monthly expenses. In addition to being more efficient, ENERGY STAR Homes guarantee a build quality superior to that of a code-built home. A third-party verification system encompassed in the ENERGY STAR qualification process ensures that a higher building standard is met, making ENERGY STAR Homes more comfortable and more durable. ENERGY STAR Homes are required to have properly installed insulation, high-performance windows, air-tight construction and ductwork, and more efficient heating and cooling equipment, along with efficient appliances and lighting. These features can translate into a number of consumer benefits including a higher performance home that keeps owners more comfortable, increases annual savings, and diminishes the home's negative impact on the environment (*Features & Benefits*, n.d.).

Despite these positive attributes, market penetration of ENERGY STAR Homes is limited, about 21% nationwide as of 2009 (2009 ENERGY STAR, 2009), and builders are hesitant to undertake the necessary education and financial investment to modify their construction practices and techniques. Similarly, prospective home buyers are cautious about spending more on efficient housing because of the added up-front costs and their subsequent

ability to qualify for a mortgage. Additionally, potential ENERGY STAR home buyers are often unaware of the long-term advantages of high efficiency homes.

The North Carolina Energy Efficiency Alliance

The North Carolina Energy Efficiency Alliance (NCEEA) is an organization created with the intention of changing the prevailing outlook of the ENERGY STAR qualification process. Many home builders feel that additional investment in ENERGY STAR qualification is not recoverable at the time of sale, and appraisers and lenders often overlook the value associated with a more efficient home. Little research, however, has been conducted to investigate the legitimacy of these claims in today's market. One purpose of the NCEEA is to quantitatively investigate the impact of the ENERGY STAR label and its effect on new home sales market performance.

The NCEEA was initially funded through a grant from the North Carolina State Energy Office as part of the American Recovery and Reinvestment Act (ARRA) of 2009. The organization's purpose is to increase the number of high efficiency homes built in the state. The four founding partners of the NCEEA include Appalachian State University, Southern Energy Management, Advanced Energy, and the North Carolina Solar Center. The NCEEA bridges the gap between many of the key energy-efficient housing industry stakeholders, including home builders, Home Energy Raters, designers, appraisers, real estate agents, lenders, electric and gas utilities, and other related organizations. The NCEEA aims to benefit members of the new home-buying industry by overcoming market barriers through the education of home buyers, the training of home builders and real estate agents, and the strengthening of the Home Energy Raters (HERS) network. By addressing each of these groups, the NCEEA hopes to stimulate and support the market for energy-efficient homes in

the state of North Carolina and to pave the way for the adoption of energy-efficient building practices in other states.

The NCEEA's goals include: (a) increasing the number of energy-efficient homes built in the state; (b) increasing awareness of the benefits of energy efficiency amongst consumers and home buyers; (c) educating appraisers, real estate agents, and lenders to recognize the value of energy-efficient features; (d) strengthening the HERS network; (e) educating builders on the importance of energy efficiency and appropriate construction methods; (f) building collaborative relationships with various professionals in the home construction industry; and (g) developing policy recommendations to improve the future of energy-efficient homes. The Alliance provides education and training resources for each of the key stakeholders involved in the home building industry. These trainings include workshops, networking opportunities, and printed publications and resources (*About the Alliance*, 2011).

The NCEEA provides builders and home buyers with the necessary education and industry contacts to build high efficiency homes, but that only provides half the solution. Builders are still concerned with the extra financial investment tied to building high performance homes. One of the NCEEA's goals is to educate lenders and appraisers of the added value an energy-efficient home holds compared to a standard code-built home. This process will hopefully yield higher appraisal values and better mortgage incentives for homes built to a certified efficiency standard, and would reassure builders and home buyers that their extra investment will not be lost. The NCEEA sponsored this investigation in order to discover and share information pertaining to how the market currently values ENERGY STAR qualified homes regardless of their appraised values. Uncovered evidence suggesting

ENERGY STAR Homes encompass a competitive market advantage can be used by the NCEEA to educate lenders and appraisers. More importantly, this information can be used as justification by appraisers to adjust their valuation practices by assigning value to energy efficient features and certifications.

Valuation of Energy-efficient Homes and Home Features

The process of changing appraisal practices commenced decades ago after a number of studies discussed later in this section found that consumers placed a higher value on more energy efficient homes. Unfortunately, despite this evidence, appraisal practices did not change to properly reflect the added value energy efficient features contribute to a home's total worth, and change is still needed in appraisal practices today. Additionally, many of these studies recognized that the savings on monthly utility costs that energy-efficient homes yield are not considered when potential home buyers seek to obtain mortgages. This means that, despite having an appreciable decrease in monthly expenditures, lenders do not consider this money available to use on mortgage payments. Furthermore, even if energy-efficient home features pay for themselves in energy savings over time, investing in them in the first place can adversely affect one's ability to qualify for a mortgage because of the higher up-front cost. This problem results from the standard underwriting criteria utilized in the lending industry, which take into account an applicant's housing-cost-to-income ratio, debt-to-income ratio, and loan-to-home value ratio. The housing-cost-to-income ratio does not take into account the monthly costs associated with owning the home, including items like monthly utility bills. Instead, it utilizes a preset percentage constraining limit, traditionally set at 28% of the applicant's income, designed to capture what the potential home buyer can afford. Unfortunately, the savings earned from having energy-efficient features in the home

are not captured by this predetermined percentage. This practice ignores that high performance home buyers actually have better housing-cost-to-income ratios and should therefore qualify for a larger mortgage (Nevin & Watson, 1998). In short, because owners of high efficiency homes spend less on monthly utility bills, they have more money available to make monthly mortgage payments, resulting in the ability to pay off a larger mortgage. Regrettably, standard lending practices ignore this benefit of purchasing an energy-efficient home. Additionally, unless energy efficient features are valued during the appraisal process, a practice not commonly implemented (Ball, 2011), the home's true value will not be accurately captured. This misrepresentation becomes problematic when the home's loan-to-value ratio is calculated. Since the home will cost more to produce than a standard code built home, an energy efficient home's value will not increase proportional to its additional cost. Therefore, the loan-to-value ratio is negatively impacted by not adequately capturing additional energy efficient features in the home's total value.

Historically, there is reason to believe that homes built to a higher efficiency standard are worth more. In the early-to-mid-1970s an oil embargo in the US resulted in drastically higher oil prices. At that time, many US homes were heated with heating oil, and as a result the cost to heat homes in the US increased dramatically. Consequently, during the late 1970s and early 1980s home construction in the US became much more focused on energy savings in order to keep heating costs down. Unfortunately, this trend did not continue when oil prices dropped by the mid-1980s, and building efficiency lapsed thereafter and through much of the 1990s (Nevin, 2010). However, several interesting trends in the housing market began to develop around this time that were directly linked to the fluctuation of heating or energy costs and improvements in efficiency.

A study conducted by Halvorsen and Pollakowski (1981) analyzed a sample of 269 homes sold between 1970 and 1975 in Seattle, Washington. They found that homes which utilized a more efficient heating method rather than heating oil sold for an average premium of about $4,600. Additionally, Corgel, Goebel, and Wade (1982) found that people were willing to spend more on energy-efficient homes as long as there was a rational trade-off between utility bill savings and mortgage payment increases. This conclusion was reached by correlating a sample of 100 homes from Lubbock, Texas, acquired in 1978 and 1979, and aerial infrared photos of them with the subsequent buying patterns exhibited by consumers. It was found that consumers paid on average over $3,400 more for homes that demonstrated energy efficiency superiority evidenced by the infrared photos and utility bills compared to nearby properties that were less efficient. This information was interpreted as the consumer making a rational trade-off, spending more money on the efficient home and gaining savings through accumulated energy use reductions. It also meant that consciously or subconsciously homeowners were willing to spend more on an energy-efficient home as long as the energy-efficient features provided monthly utility bill savings in excess of their added monthly mortgage cost. This result has been replicated or substantially supported by other findings since the study was initially published. Despite these studies' evidence that consumers already place an additional value on comparatively energy efficient homes and home features when it is financially advantageous, they have done little to change the valuation process implemented by the appraisal industry.

Johnson and Kaserman (1983) completed a study using MLS data from Knoxville, Tennessee containing a sample of 1,317 homes from 1978 and their corresponding utility data. The homes included in the sample were detached, single family homes that were heated

by either electricity or natural gas provided by the Knoxville Utilities Board (KUB). Using MLS sales records, KUB utility records, and a correlative hedonic price indexing model, they found that for every dollar reduction in a home's annual energy consumption, its value increased by $20.73.

Dinan and Miranowski (1989) set out to replicate these findings using a similar correlative model. They sampled 234 detached, single family homes from Des Moines, Iowa collected in 1982 and acquired their corresponding utility data. They found that a home's value increased slightly less, an average of $11.63, for every one dollar reduction in home fuel expenditures. This variance may be attributed to the fact that the methodology used by Dinan and Miranowski accounted for billing period differences, average heating degree days, and the calculated heating requirement to maintain home temperatures of 65 degrees Fahrenheit. Therefore, their model reflected the structural efficiency of the home (as previous correlative hedonic price indexing models had) and included variables purported to account for occupant behavior variations. However, many details that would allow for verification of Dinan and Miranowki's model and the replication of their study were absent in the published report, leading several to question the appropriateness of the model itself.

In 1990, Horowitz and Haeri achieved similar results using a sample of 42 detached, single family homes built in 1984 or 1985 in a two-county region of Washington State. They employed a model more similar to Johnson and Kaserman (1983) that correlated utility records, home characteristics data, and house sale price data. They found that the value of every one dollar reduction in annual electricity bills increased the home's value $12.52. The main limitation of this investigation was the small sample size. However, nearly ten years later similar findings were uncovered by Nevin and Watson (1998), who found that home

values increased $23.41 for every one dollar reduction in annual utility bills through examining American Housing Survey data from 1991, 1993, and 1995.

Although the per-dollar gain in home values among these various studies differed by as much as $11, it is nevertheless clear that they established a precedent that consumers are willing to pay more for energy efficiency in homes, as reflected by actual sales data. Furthermore, this conclusion suggests that homes achieving green building certifications, like ENERGY STAR, should also be valued more by consumers because these certifications themselves are indicative of a home possessing superior energy efficiency. Specifically, ENERGY STAR Homes are known to reduce energy costs around 15-30%. Therefore, historical findings indicate that these homes should encompass an appreciable increase in market performance.

ENERGY STAR Homes implement a range of methodologies in a whole-house approach to improve a building's energy efficiency. One method employed by ENERGY STAR Homes to achieve part of their 15-30% reduction in energy consumption is through the use of effective insulation. Studies have demonstrated that simply improving a home's insulation and overall thermal integrity alone can add to its value. Laquatra (1986) sampled 81 homes constructed through a government program in Minnesota in 1980. He demonstrated that improving a home's thermal integrity factor led to an increase in the home's value by $2,510 for every one point increase in the thermal integrity factor. Unfortunately, the thermal integrity factor implemented by Laquatra is no longer used and was in fact rarely used by researchers other than Laquatra, making it difficult to generalize these findings. However, additional evidence suggesting improving a home's insulation adds to its value was reported by Longstreth (1986). Longstreth found that adding insulation to a

home's walls and ceiling increased its value. Specifically, a one inch increase in wall insulation was shown to increase the home's value by $1.90 per square foot of conditioned space. Concurrently, Longstreth found a one-inch increase in ceiling insulation increased the home's value by $3.37 per square foot of conditioned space. This information was ascertained by sampling 505 detached, single family homes sold between 1971 and 1978 in Columbus, Ohio. MLS data, county tax and deed records, and US Census data were used, but Longstreth's work was criticized because his published findings only applied to certain demographics, namely young and middle-aged home buyers.

More recently, there has been additional evidence suggesting the positive role energy efficiency and energy efficiency certifications can play on market performance. An investigation conducted by Griffin (2009) found statistically significant evidence that green certifications, including ENERGY STAR, played a positive role in a home's market performance. Specifically, Griffin found that homes certified in various green building certification programs in Portland, Oregon sold for an average of 4.2% more. Griffin also found that these same homes sold 18 days faster compared to non-certified homes. Additionally, certified homes in Seattle, Washington were found to sell for an average of 9.6% more, but did not demonstrate differences in time spent on the market. An investigation of the housing market in Asheville, NC conducted by Mosrie (2011) found that green buildings were able to defy the downward trend in the housing market. Mosrie found that the price per square foot of green homes actually increased steadily since 2007, while standard homes' prices per square foot declined. A market analysis conducted by Atlanta, Georgia-based eco-broker Matthews (2009) found that green certified homes, including ENERGY STAR Homes, sold for a higher percentage of their asking price (94.5% vs. 90.9%) and spent

an average of 31 fewer days on the market compared to conventional homes. Another market analysis conducted by Quick Turn Quality Appraisals, LLC, utilizing the Triangle MLS in North Carolina, found in 2010 that new high performance homes with certifications sold for 12.9% more overall, an average of $13.82 more per square foot, and were on the market 42 fewer days compared to non-certified homes (Argeris, 2010). These previous findings are encouraging and suggest that ENERGY STAR qualified homes do have a market advantage compared to non-qualified homes, meaning there could be a significant financial return in investing in the ENERGY STAR program.

CHAPTER 3: RESEARCH METHODOLOGY AND FINDINGS, PART I: ENERGY STAR HOMES MARKET OVERVIEW

Description of ENERGY STAR Market Overview Research Methods

The ENERGY STAR market overview, Part I of this study, aimed to determine if there is a market advantage for new homes that have obtained ENERGY STAR qualification compared to code-built homes listed in the Triangle MLS database for the year 2010. A market advantage for the purposes of this investigation was operationally defined along the dimensions of homes (a) having reached a higher sale price, (b) having sold for a larger percentage of the list price, (c) having sold at a higher price per square foot, and/or (d) having spent fewer days on the market before sale. Data examining a home's value (sale price, price per square foot) are important indicators of whether an ENERGY STAR Home is valued more because of its ENERGY STAR label and the energy efficiency tied to that certification compared to non-ENERGY STAR Homes. Additionally, knowing if ENERGY STAR Homes sell for a greater percentage of the listing price can be an indicator to home builders of consumer willingness to pay for energy efficiency as well as potential room for profitability. Furthermore, the carrying costs associated with holding a new home while a buyer is found can significantly impact financial return on investment for home builders. Therefore, examining if ENERGY STAR Homes spend less time on the market is of particular importance to builders and realtors.

Sample

The investigation utilized two sets of data for statistical comparison. Both sets of data contained only information from sales of detached single-family dwellings. The first data set consisted of all ENERGY STAR qualified new homes found in the Triangle MLS database for the year 2010. The second set of data consisted of all other homes that were not listed in the Triangle MLS database for 2010 as having achieved any green building certification. Several different subsets of this data were analyzed for the purpose of examining market advantages that might have been present in specific geographic areas. These areas included examining a five-county area within the Triangle MLS as well as examining each of the five counties separately. The five counties were chosen because they contained the majority of home sales in the overall region encompassed by the Triangle MLS. The sample size for the entire Triangle MLS for 2010 and the geographic subsets sample sizes are summarized in Table 1.

Table 1. *ENERGY STAR Market Overview Sample Sizes by Geographic Area*

Sample Size by Geographic Area			
Geographic Area	**ENERGY STAR Homes**	**Non-certified Homes**	**Total**
Entire Triangle MLS	928	3,184	4,112
Five County Area	875	2,366	3,241
Chatham County	48	112	160
Durham County	175	255	430
Johnston County	40	485	525
Orange County	30	44	74
Wake County	582	1,470	2,052

Data Collection

All data used were generated from the Triangle MLS database from the year 2010. The Triangle MLS contains data on the majority of new homes sold in central North

Carolina, comprising most importantly the communities of Raleigh, Durham, and Chapel Hill, and is one of the few such real-estate listing services in North Carolina that indicates whether homes contain green features or any green building certifications.

ENERGY STAR Homes data set.

The first set of data was generated from all homes listed as ENERGY STAR qualified and that had no other green building certification(s) sold in 2010 in the Triangle MLS. Homes with ENERGY STAR qualification and additional building certifications, such as LEED, NAHB, NCHBH, etc., were not considered. The present investigation is interested in the impact of ENERGY STAR qualification alone, and the additional investments needed for homes earning dual or more certifications could have masked or otherwise confounded the results of the study. Additionally, ENERGY STAR Homes were identified in ten separate counties of the Triangle MLS. Homes from the counties of Wake, Durham, Orange, Chatham, and Johnston were considered especially important because these counties contained an overwhelming majority of the ENERGY STAR Homes listed by the Triangle MLS (over 94%). These important geographic area subsets of the data were analyzed, as outlined in Table 1.

Code-built homes data set.

The second set of data was drawn from the 2010 Triangle MLS database and contained any home with no building certification(s) listed. The homes were also new construction, single family, detached homes sold in 2010. These homes were examined as outlined in Table 1. This analysis included comparisons of market performance against ENERGY STAR Homes for the entire geographic area encompassed by the Triangle MLS,

for a five-county subset of the Triangle MLS, as well as for each of the five counties individually.

Data Analysis Procedures

Data were analyzed using simple statistical comparisons similar to those employed by other market analyses (Matthews, 2009; Argeris, 2010). Group means were calculated for each variable of interest and differences between the group means are reported. This procedure was carried out on home data for the entire geographic area encompassed by the Triangle MLS database. This procedure was replicated for a five-county geographic subset of the data as well as for each of the five counties comprising the majority of ENERGY STAR Home sales. A summary of the sample sizes for each geographic area of interest can be found in Table 1.

ENERGY STAR Homes Market Overview Results and Discussion

Data analyses were carried out on a number of variables and the results and subsequent discussion are given below. The groups being compared were ENERGY STAR Homes and code-built homes. Group means were compared on a number of different dimensions to determine if ENERGY STAR qualified homes held a market advantage over non-qualified homes. Group means were examined for (a) sale price; (b) sale price-to-list price ratio (i.e., the percentage of the listing price the home sold for); (c) price per square foot, and (d) number of days spent on market.

Sales Price Analysis

A home's sale price is a good indicator of market performance because it demonstrates what consumers are willing to pay for a product, in this case homes that are

either ENERGY STAR qualified or not. The sale price data was generated from the data field on the MLS data sheet labeled “sale price” and is the recorded price for which the home sold. When examining the data comparing reported sale prices for the entire Triangle MLS region, ENERGY STAR Homes, *M* = $331,222, were found to sell for more than code-built comparable homes, *M* = $284,826. ENERGY STAR Homes, *M* = $337,269, also sold for more than code-built homes, *M* = $313,736, when examining the five-county region contained within the larger Triangle MLS region. Finally, ENERGY STAR Homes sold for higher sales prices in three of the five individual counties. Results of the analysis are shown in Figures 1-3. A summary of group means and mean differences can be found in Table 2.

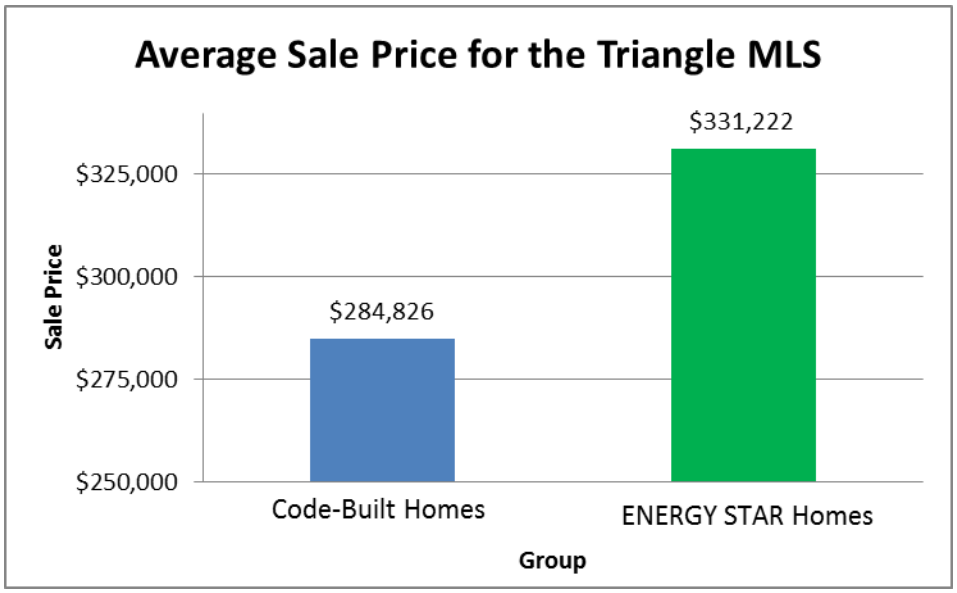

Figure 1. Average sale price for homes in the entire (ten county) Triangle MLS region.

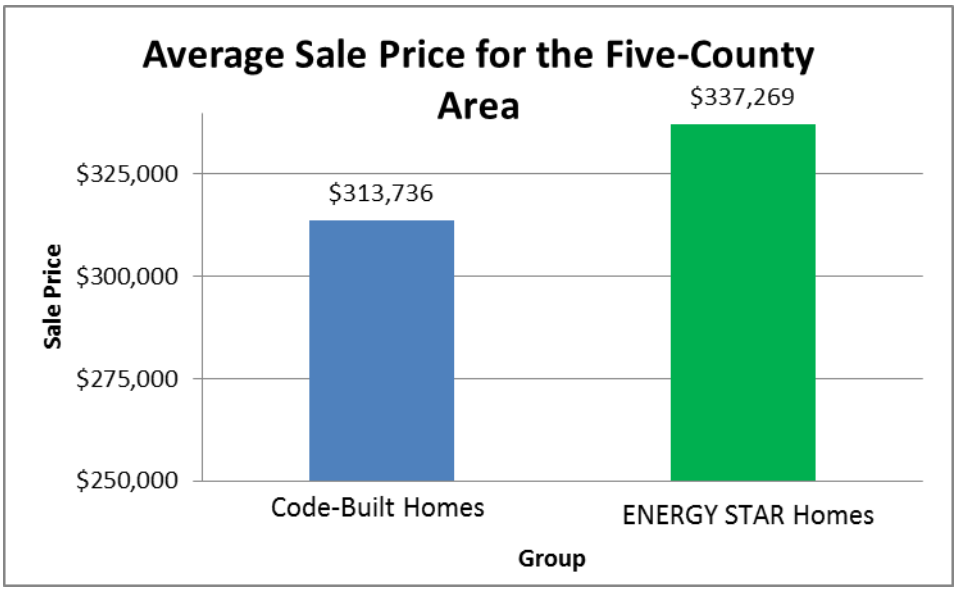

Figure 2. Average sale price for homes in the selected five-county region of Triangle MLS.

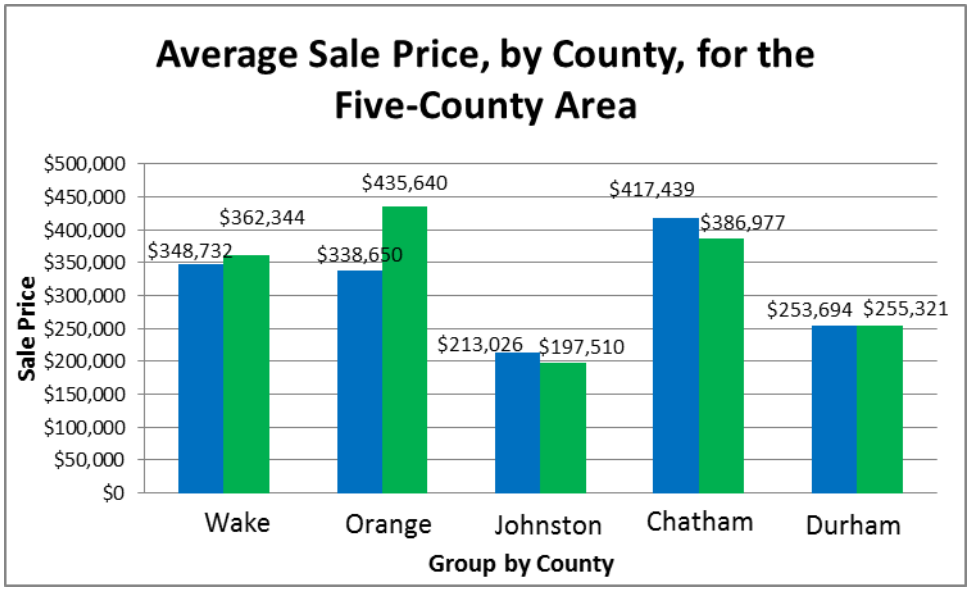

Figure 3. Average sale price for homes in each of the five selected counties in the Triangle MLS. ENERGY STAR Homes are shown in green; code-built homes are shown in blue.

Table 2. *Average Sale Price Data, Means, and Mean Differences*

Average Sale Price		
Entire Triangle MLS	**Mean**	**Mean Difference**
ENERGY STAR Homes	$331,222	ENERGY STAR Homes sold
Code-Built Homes	$284,826	$46,396 more
Five-County MLS Region		
ENERGY STAR Homes	$337,269	ENERGY STAR Homes sold
Code-Built Homes	$313,736	$23,533 more
Individual Counties		
Wake		
ENERGY STAR Homes	$362,344	ENERGY STAR Homes sold
Code-Built Homes	$348,732	$13,612 more
Orange		
ENERGY STAR Homes	$435,640	ENERGY STAR Homes sold
Code-Built Homes	$338,650	$96,990 more
Johnston		
ENERGY STAR Homes	$197,510	ENERGY STAR Homes sold
Code-Built Homes	$213,026	$15,516 less
Chatham		
ENERGY STAR Homes	$386,997	ENERGY STAR Homes sold
Code-Built Homes	$417,439	$30,442 less
Durham		
ENERGY STAR Homes	$255,321	ENERGY STAR Homes sold
Code-Built Homes	$253,694	$1,627 more

These findings indicate that ENERGY STAR qualified homes in the Triangle MLS sold for more than code-built homes in 2010. Very large differences were exhibited when examining the entire Triangle MLS dataset (ENERGY STAR Homes sold for an average of $46,396 more) and the data for the five-county region as a whole (ENERGY STAR Homes sold for an average of $23,533 more). Although results are positive for ENERGY STAR market performance, it is important to realize that actual sales price differences may be smaller than those exhibited here. One reason is that ENERGY STAR Homes may have a greater proportion of homes that are larger in size compared to code-built homes. Size and location tend to be significant predictors of home prices so it is important to consider each group's average home size in addition to its sale price. If ENERGY STAR Homes are on

average larger in size it can be expected that they would also attain a higher sale price. In fact, this was found to be the case when examining the data for the entire Triangle MLS. ENERGY STAR Homes averaged 2,664 square feet, while code-built homes averaged 2,573 square feet. However, this difference is likely not great enough to account for the rather large sale price gap of over $46,000 between the two groups, indicating that ENERGY STAR qualification might contribute to increased sale prices. Supporting this notion is the fact that when the five-county region home sizes were examined, ENERGY STAR Homes were actually smaller on average, 2,700 square feet, compared to code-built homes, which averaged 2,724 square feet. This means that despite being smaller in size ENERGY STAR Homes still sold for an average of over $23,000 more. This finding of smaller ENERGY STAR Homes selling for more than larger code-built homes was demonstrated in several individual counties including Durham, Orange, and Wake. Potentially, this means that ENERGY STAR Home builders are able to invest in less materials (i.e., a smaller home), but charge more for it in these county markets. Additionally, in one of the counties where ENERGY STAR Homes did not sell for higher prices than their code-built counterparts, Chatham County, ENERGY STAR Homes were smaller in size and therefore expected to sell for less. In this county ENERGY STAR Homes seemed to have similar market performance as code-built homes although they were around 300 square feet smaller in size. Using a modest value estimate of $100 per square foot would mean the ENERGY STAR Homes should be selling for around $30,000 less, which is approximately what was demonstrated in the data. Only in Johnston County did ENERGY STAR Homes truly demonstrate no recognizable market advantage, where ENERGY STAR Homes were actually larger in size yet did not sell for higher prices. It is important to additionally note that Johnston County

only contained 40 ENERGY STAR Home sales and these homes were compared to 485 non-certified homes. Not only does this represent a modest 12.7% of the overall population of 4,112 homes, but it could also be that 40 ENERGY STAR Home sales is not large enough to accurately reflect the larger geographic trends.

Unfortunately, examining a home's sale price alone is not the best indicator of market advantage. As discussed earlier, this methodology fails to adequately consider a number of variables of the homes being compared, including the home's size. The market overview, in other words, did not provide a comparison of ENERGY STAR Homes against code-built homes that were the same or very similar sizes, and variations in sale prices are likely to be at least in part due to size inequities as well as to other features. Instead, this market overview provided only a macro comparison of the sale prices of these two groups of houses. A better measure for judging market performance would eliminate size variations between the two groups by examining a home's price per square foot. Such a measurement will be discussed later in this report.

Proportion of List Price Analysis

The proportion of list price to sale price, or the percentage of the list price a home sells for, can be an indicator of what value consumers place on homes. It may also be an indication of their level of willingness to pay for a particular item or, counter-intuitively, how much of a discount is needed before consumers become willing to make the purchase. This data point also indicates the potential profit a builder can attain on a home because many homes are priced at some markup beyond what it costs the builder to build. Having an idea of whether ENERGY STAR Homes sell for a greater percentage of their list price will give builders a better understanding of the potential profit advantage they may achieve.

The percentage of the list price was determined by taking the sale price and dividing it by the list price. When examining the percentage of list price data for the entire Triangle MLS region, ENERGY STAR Homes, *M* = 98.30%, were found to sell for a greater percentage of their list price than code-built homes, *M* = 97.20%. ENERGY STAR Homes, *M* = 98.27%, also sold for a greater percentage of their list price than code-built homes, *M* = 96.99%, when examining the five-county region. Finally, ENERGY STAR Homes sold for a greater percentage of their list price than code-built homes in four of the five individual counties. Results of this analysis are shown in Figures 4 through 6. A summary of group means and mean differences can be found in Table 3.

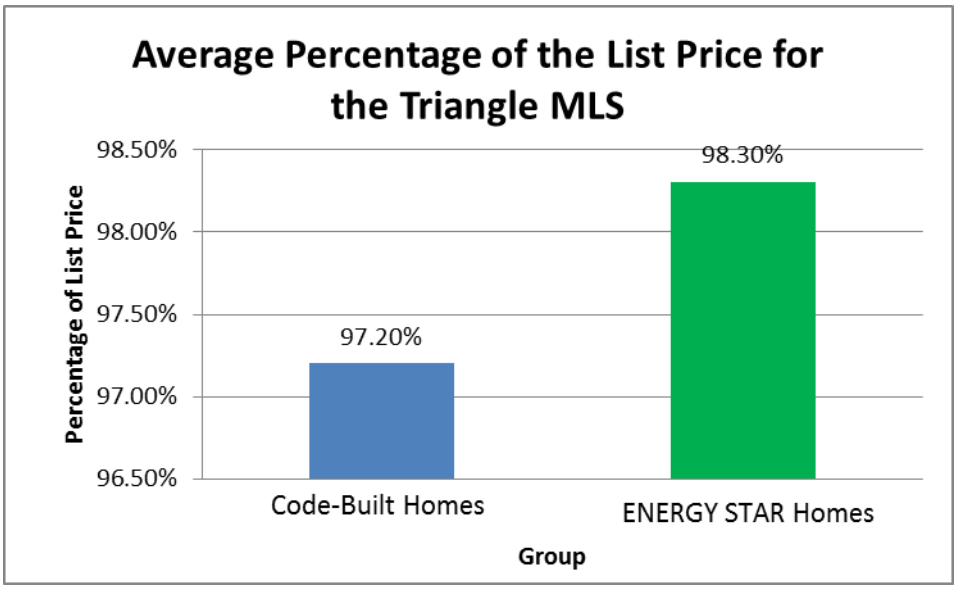

Figure 4. Average percentage of the list price a home sold at for the entire Triangle MLS.

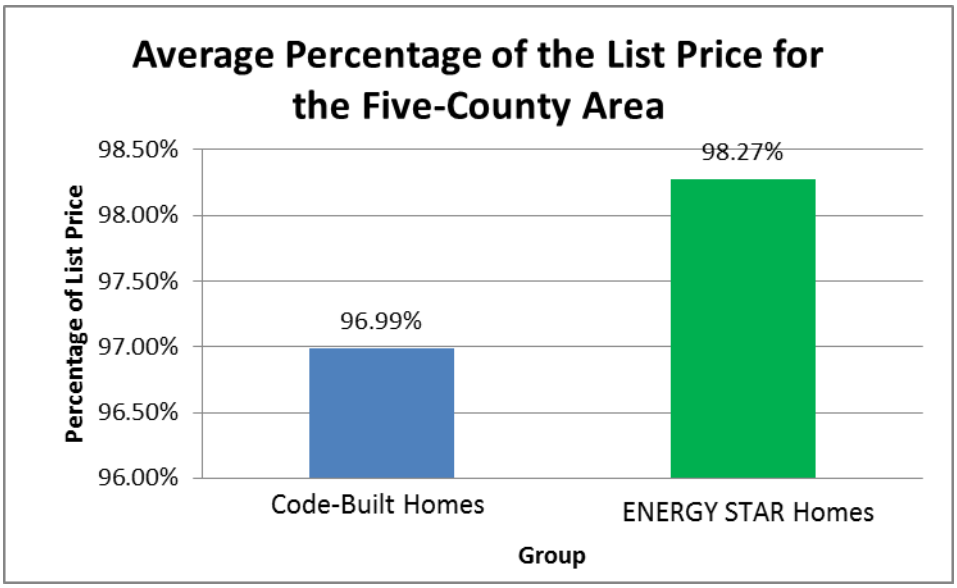

Figure 5. Average percentage of the list price a home sold at for the five-county region.

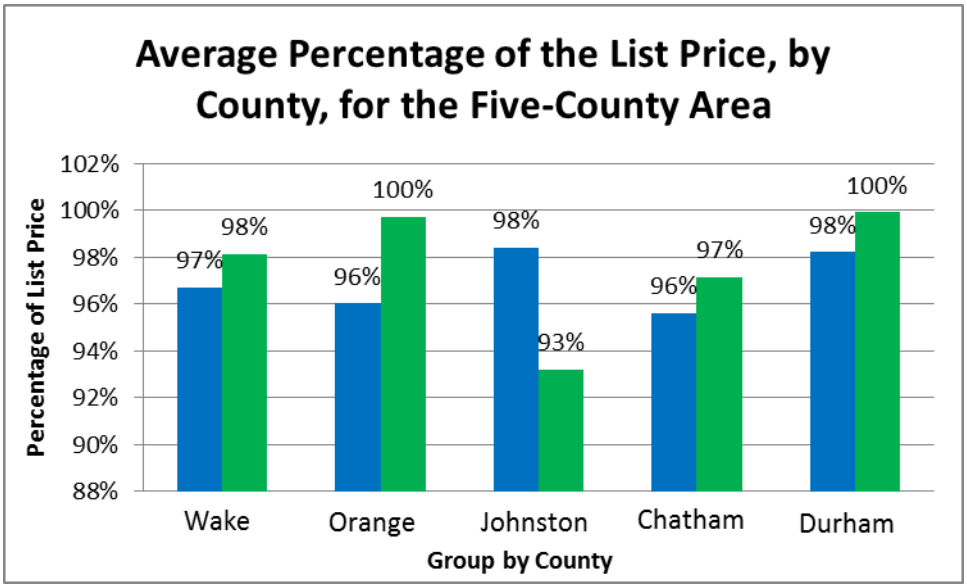

Figure 6. Average percentage of the list price at which a home sold in each of the five selected counties in the Triangle MLS. ENERGY STAR Homes are shown in green, code-built homes are shown in blue.

Table 3. *Average Percentage of the List Price at which a Home Sold, Means, and Mean Differences*

Percentage of List Price		
Triangle MLS	**Mean**	**Mean Difference**
ENERGY STAR Homes	98.30%	ENERGY STAR Homes sold at a
Code-Built Homes	97.20%	1.1% higher percentage
Five-County Region		
ENERGY STAR Homes	98.27%	ENERGY STAR Homes sold at a
Code-Built Homes	96.99%	1.29% higher percentage
Individual Counties		
Wake		
ENERGY STAR Homes	98.14%	ENERGY STAR Homes sold at a
Code-Built Homes	96.71%	1.43% higher percentage
Orange		
ENERGY STAR Homes	99.74%	ENERGY STAR Homes sold at a
Code-Built Homes	96.02%	3.72% higher percentage
Johnston		
ENERGY STAR Homes	93.21%	ENERGY STAR Homes sold at a
Code-Built Homes	98.40%	5.17% lower percentage
Chatham		
ENERGY STAR Homes	97.15%	ENERGY STAR Homes sold at a
Code-Built Homes	95.61%	1.55% higher percentage
Durham		
ENERGY STAR Homes	99.91%	ENERGY STAR Homes sold at a
Code-Built Homes	98.22%	1.69% higher percentage

The data on percentage of list price suggests that ENERGY STAR Homes sell for a higher proportion of their list price. However, this difference was minimal, only 1.1% overall, when considering the entire Triangle MLS dataset. Still, when considering that the average home value for the entire Triangle MLS is around $300,000, 1.1% represents approximately $3,300 additional profit that could be gained if the home were ENERGY STAR qualified. This additional profit on average is more than enough (in fact over twice the cost) to cover costs to the builder associated with ENERGY STAR qualification. Orange County demonstrated the highest percentage increase, 3.72% more than code-built homes, than any other examined area. Interestingly, in only one county, Johnston County, ENERGY STAR Homes sold for a smaller percentage of the listing price. This is one of the counties where ENERGY STAR Homes also did not outperform code-built homes in sale price and it

may be that builders in this area have a different approach to selling ENERGY STAR Homes than in other counties. A more systematic investigation may be warranted to better understand the Johnston County anomaly, and whether those outcomes might be more typical of certain types of geographic areas.

Price Per Square Foot Analysis

The price per square foot of a home is calculated by dividing a home's sale price by its reported conditioned (i.e., heated and/or cooled) square footage. Understanding the value of a home on a per-square foot basis is important because it creates a standard unit of measurement that can be equally applied to any home. Examining only the sale price of a home is helpful, but cannot accomplish a universal unit defining how the final sales price was reached in relationship to the home's size. Because the market overview component of this study could not control for inequities between ENERGY STAR and code-built homes a measurement of this kind is of the highest importance. Examining a home's price in terms of a comparable unit scale is a better method for determining market performance because it further levels the playing field by removing the impact of size variations as a determinant of sale price. When examining the price per square foot data for the entire Triangle MLS region, ENERGY STAR Homes, M = \$124.33, were found to sell for more than code-built homes, M = \$110.70 per square foot. ENERGY STAR Homes, M = \$124.91, also sold for a higher price per square foot than code-build homes, M = \$115.17 per square foot, when examining the five-county region. Finally, ENERGY STAR Homes sold for a higher price per square foot than code-built homes in four of the five individual counties. Results of the analysis are shown in Figures 7 through 9. A summary of group means and mean differences can be found in Table 4.

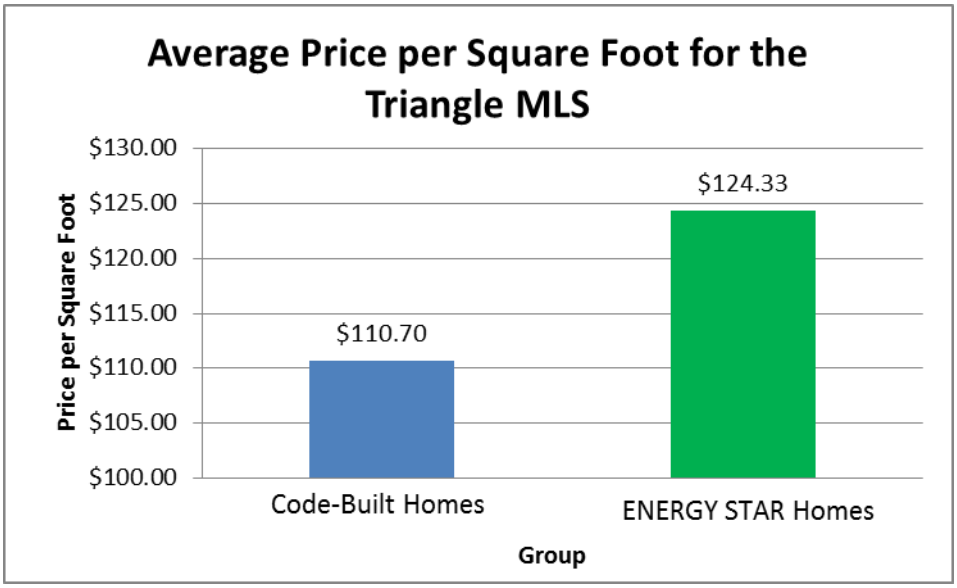

Figure 7. Average price per square foot for homes in the entire Triangle MLS.

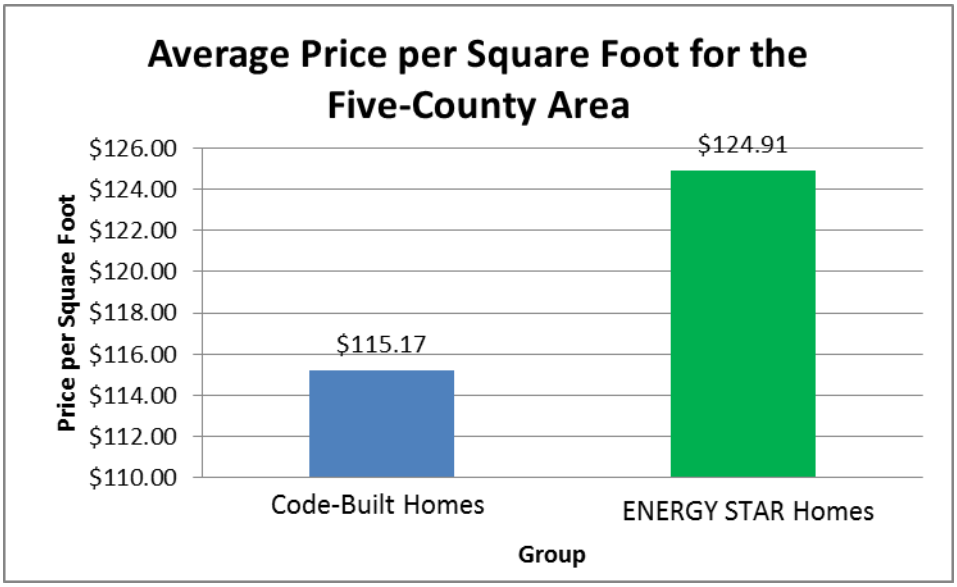

Figure 8. Average price per square foot for homes in the five-county region of the Triangle MLS.

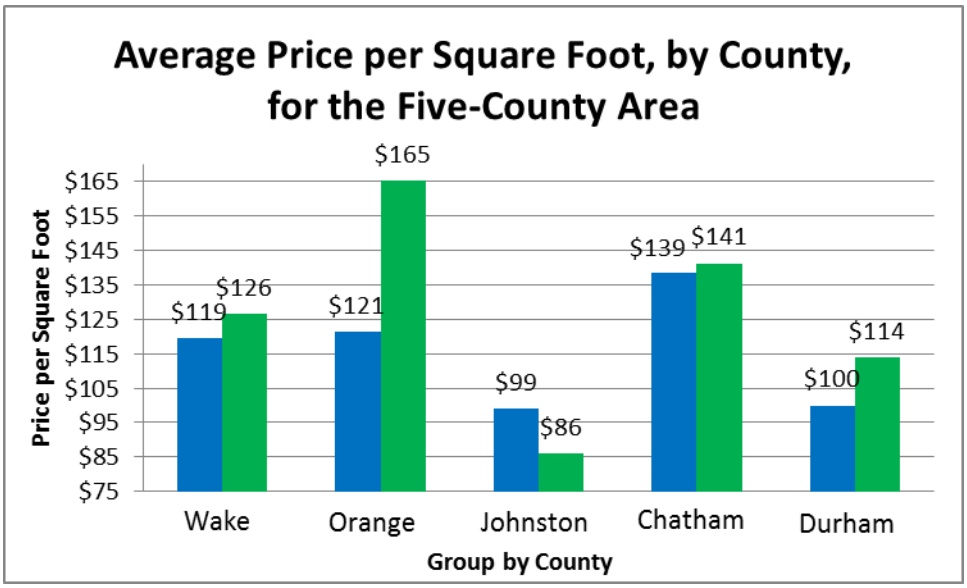

Figure 9. Average price per square foot for homes in the selected counties of the Triangle MLS. ENERGY STAR Homes are shown in green; code-built homes are shown in blue.

Table 4. *Average Price Per Square Foot, Means, and Mean Differences*

Average Price per Square Foot		
Triangle MLS	**Mean**	**Mean Difference**
ENERGY STAR Homes	$124.33	ENERGY STAR Homes sold for
Code-Built Homes	$110.70	$13.63 more per sq ft
5 County Region		
ENERGY STAR Homes	$124.91	ENERGY STAR Homes sold for
Code-Built Homes	$115.17	$9.74 more per sq ft
Individual Counties		
Wake		
ENERGY STAR Homes	$126.43	ENERGY STAR Homes sold for
Code-Built Homes	$119.39	$7.04 more per sq ft
Orange		
ENERGY STAR Homes	$165.08	ENERGY STAR Homes sold for
Code-Built Homes	$121.38	$43.70 more per sq ft
Johnston		
ENERGY STAR Homes	$86.20	ENERGY STAR Homes sold for
Code-Built Homes	$99.08	$13.06 less per sq ft
Chatham		
ENERGY STAR Homes	$141.23	ENERGY STAR Homes sold for
Code-Built Homes	$138.55	$2.69 more per sq ft
Durham		
ENERGY STAR Homes	$113.93	ENERGY STAR Homes sold for
Code-Built Homes	$99.88	$14.05 more per sq ft

The analyses regarding price per square foot revealed strong evidence indicating ENERGY STAR Homes encompass a market advantage above that of code-built homes. These results largely followed the trends uncovered when examining the sale price data, but yielded even stronger evidence. This finding means that when compared in terms of a universal unit measuring price the ENERGY STAR Homes from the study demonstrated an even greater market advantage. When examining the entire MLS database ENERGY STAR Homes sold for over $13.00 more per square foot compared to the code-built homes. This result was repeated to a slightly smaller degree when examining the five county region, where ENERGY STAR Homes sold for nearly $10.00 more per square foot. Concurrent with the results from the proportion of list price data, Orange County showed the strongest market advantage for ENERGY STAR Homes, selling for over $43.00 more per square foot. Johnston County was again the only county where no market advantage was demonstrated. Since ENERGY STAR qualification represents a modest additional investment, typically between 0.5%-1.5% (depending on economies of scale) of its retail value, the likelihood of recovering initial investment and even increasing profit margins for the builder is good given the higher price per square foot value of ENERGY STAR qualified homes.

Days on Market Analysis

The data concerning the number of days a home spent on the market originates from a data field contained within the MLS datasheets. It is important to note that the MLS datasheets contain two data fields concerning the days a home spent on market and only one is examined by this market overview. The first data field pertains to the days a home has spent on the market for its most current listing. The second includes a cumulative count of the days a home has spent on the market for its current listing, in addition to any previous

listings that particular home may have had. Often, if a home has spent a relatively long period of time on the market, the buyer may choose to switch realtors or pull the home from the market and relist it later. Relisting the home will reset the first data field so that when the home comes back on the market, its listed days on market resets to zero. This act keeps the days on market count low and is often strategically employed by realtors and homeowners to discourage lowball offers. However, this day count is not representative of the true amount of time a home has spent on the market. The current analysis examines the cumulative days, for all listings, a home has spent on the market. However, this number is still not a perfect indicator of the true time a home has spent on the market. In some select few instances the number may be an underestimate of the true time a home has spent on the market. Such instances are rare, but could occur if a seller was able to acquire a different MLS number when relisting or if the home was on the market for any period of time without an MLS number, as could be the case if the owner/builder listed it for sale without the aid of a realtor. The analysis of the number of days spent on market examines the cumulative days spent on market tied to one MLS number for the sampled homes.

When statistically analyzing the data regarding the days the homes spent on the market for the entire Triangle MLS region, ENERGY STAR Homes, $M = 96$, spent fewer days on the market compared to code-built comp homes, $M = 138$. ENERGY STAR Homes, $M = 97$, also sold in fewer days compared to code-built homes, $M = 135$, when examining the five-county region. Finally, ENERGY STAR Homes sold in fewer days compared to code-built homes in four of the five individual counties. Results of the analysis are shown in Figures 10 through 12. A summary of group means and mean differences can be found in Table 5.

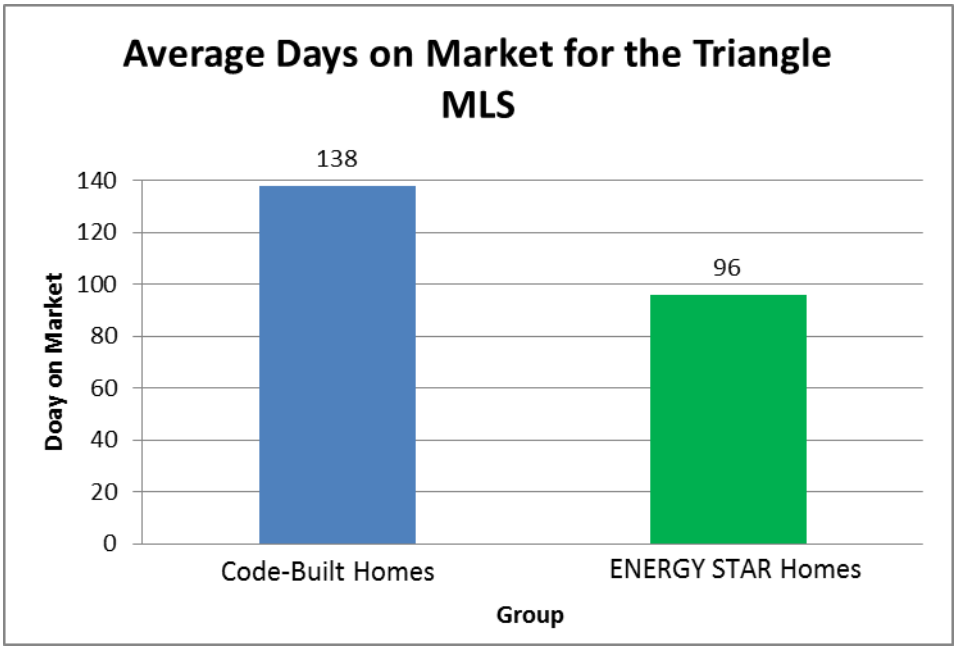

Figure 10. Average days spent on the market for homes in the entire Triangle MLS.

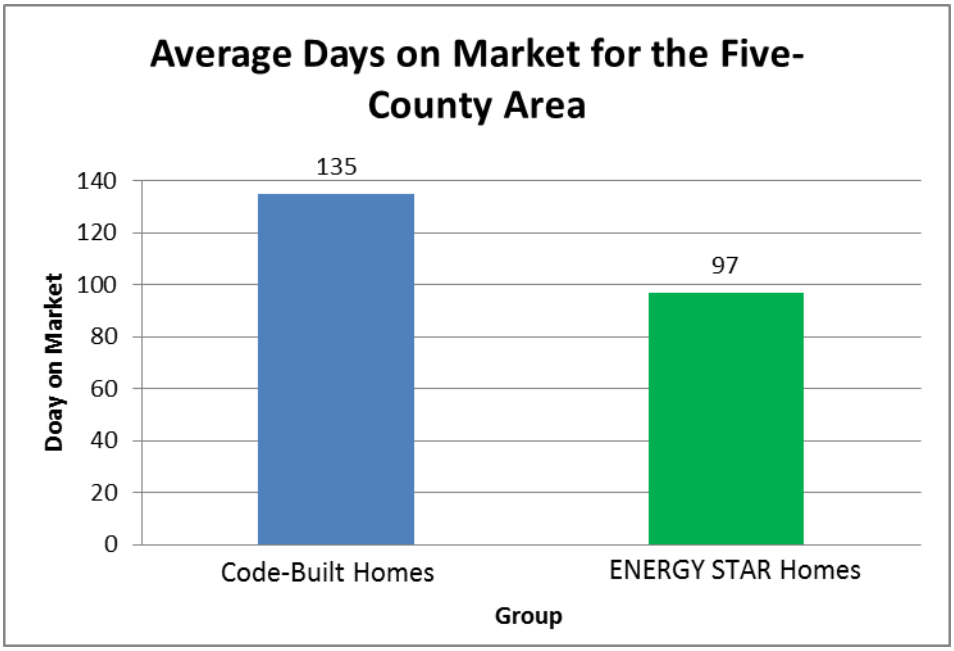

Figure 11. Average days spent on the market for homes in the five-county region of the Triangle MLS.

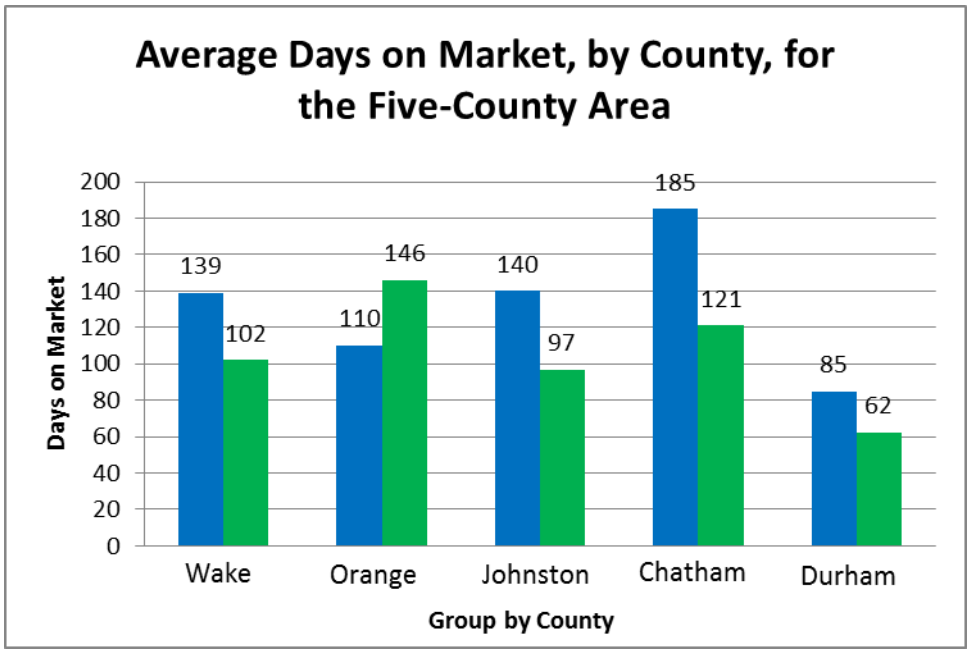

Figure 12. Average days spent on the market for homes in the selected counties of the Triangle MLS. ENERGY STAR Homes are shown in green; code-built homes are shown in blue.

Table 5. *Average Days Spent on the Market, Means, and Mean Differences*

Average Days On Market		
Triangle MLS	**Mean**	**Mean Difference**
ENERGY STAR Homes	96	ENERGY STAR Homes sold 42
Code-Built Homes	138	days faster
Five-County Region		
ENERGY STAR Homes	97	ENERGY STAR Homes sold 38
Code-Built Homes	135	days faster
Individual Counties		
Wake		
ENERGY STAR Homes	102	ENERGY STAR Homes sold 33
Code-Built Homes	139	days faster
Orange		
ENERGY STAR Homes	146	ENERGY STAR Homes sold 36
Code-Built Homes	110	days slower
Johnston		
ENERGY STAR Homes	97	ENERGY STAR Homes sold 43
Code-Built Homes	140	days faster
Chatham		
ENERGY STAR Homes	121	ENERGY STAR Homes sold 64
Code-Built Homes	185	days faster
Durham		
ENERGY STAR Homes	62	ENERGY STAR Homes sold 23
Code-Built Homes	85	days faster

ENERGY STAR Homes again demonstrated a market advantage compared to the code-built homes when considering how long a home takes to sell. ENERGY STAR Homes sold 42 days faster compared to their code-built counterparts when considering all homes in the Triangle MLS. In the five-county region, this difference shrunk slightly to a 38-day advantage. ENERGY STAR Homes were found to have sold faster than code-built homes in four out of the five counties. Surprisingly, Johnston County demonstrated its first market advantage for ENERGY STAR Homes, while Orange County was the only county where no advantage was demonstrated for ENERGY STAR Homes. When examined in conjunction with the sale price data, one possibility exists to explain why Johnston County ENERGY STAR Home performance was poor while Orange County ENERGY STAR Home performance excelled. It could be that builders in these two counties have different targets when selling homes. Orange County builders may approach the sale of a home by favoring a higher sale price while being willing to sacrifice their ability to sell the home quickly while builders in Johnston County may favor a faster turnover and are willing to reduce their asking price to meet volume sales rates. Further research is needed to investigate these claims, but the ideas seem plausible given the support from the data. The days on market data suggests that even if other demonstrated market advantages, including sale price and price per square foot, were ignored, ENERGY STAR Homes could still be potentially profitable. Profitability can occur because the ENERGY STAR Homes sell fast enough to recover a significant portion or all of the additional financial investments involved with certification by simply saving on the carrying costs of holding a home while a buyer is found.

CHAPTER 4: RESEARCH METHODOLOGY AND FINDINGS, PART II: RANDOMIZED SAMPLE COMPARISON OF ENERGY STAR HOMES

Description of Randomized Sample Comparison of ENERGY STAR Homes Research Methods

Results from Part I of this investigation yielded strong evidence that ENERGY STAR Homes do encompass a market advantage compared to code-built homes. However, these results are limited in their application because they may be impacted by inequities between ENERGY STAR and code-built homes. This deficiency results because all single family, detached, new homes listed in the Triangle MLS were compared during the market overview analyses. The homes were not matched on like dimensions and no control strategies were implemented to ensure that the homes were the same with the exception of ENERGY STAR qualification. The findings from Part I of this study, therefore, simply represent a market recap of home sales as recorded by the Triangle MLS, and differences found between ENERGY STAR Homes and their code-built counterparts could have been due to a number of factors other than ENERGY STAR qualification. For example, even homes built within a single county likely encompass geographic areas that hold differing levels of desirability and thus have relatively higher or lower property values. In this example, location and not ENERGY STAR qualification might be driving market performance variations. Part II of the ENERGY STAR Homes study represented a more tightly controlled investigation, where differences between groups were minimized so that more robust conclusions could be drawn.

Part II of this study aimed to determine if there are statistically significant market advantages for new homes that have obtained ENERGY STAR qualification compared to similar code-built homes. In this portion of the investigation, homes to be compared were matched on as many dimensions as possible such that the only major difference between compared homes was that one was ENERGY STAR qualified while the other was not. Additionally, random sampling was implemented to select the ENERGY STAR Homes used for comparisons to eliminate any systematic bias in the analyses and findings. As in Part I of this investigation, ENERGY STAR Homes were examined to see if they encompass a market advantage tied to their certification. Again, market advantage was operationally defined along the dimensions of homes having reached a higher sale price, having sold for a larger percentage of the list price, having sold at a higher price per square foot, and/or having spent fewer days on the market before sale. These analyses provide the same useful information as elaborated on in Part I of this study, informing the decision making process of home builders under pressure to maximize profitability and of home buyers who wish to get the best return on their real estate investment. However, in Part II, confidence in these analytical criteria was heightened through additional control exercised to compare similar homes as well as to gain the higher level of statistical certainty made possible through random sampling and inferential statistical analysis that was not possible to use in Part I.

Sample

Part II of this investigation used two sets of data for statistical analysis. The first data set consisted of a proportional, stratified random sample of 100 ENERGY STAR qualified, new, detached, single family homes. A proportional stratified randomized sample was implemented to ensure that the most representative sample was obtained, while still allowing

for random selection. This sampling procedure included measures to account for a home's size and location, because these are two of the larger variables thought to contribute to home pricing and to how long a home is expected to be on the market. The implemented sampling procedure will be discussed in greater depth later in this report in the section titled "ENERGY STAR Homes data set."

The second set of data consisted of 300 non-ENERGY STAR homes that were appraised to be as similar to the ENERGY STAR Homes as possible given real world constraints and construction differences. Each ENERGY STAR Home was matched with three comparable properties from the non-ENERGY STAR Homes group, creating 100 groups of four homes for comparison. These comparable properties were determined by a third-party appraisal company to be as similar to the ENERGY STAR Home in each group as possible. Furthermore, the third-party appraisal company made financial adjustments to applicable comparison properties based on the features found in each individual home and in accordance to standard appraisal industry practices. These adjustments ensured comparison property home prices were not detrimentally impacted by differences in features found between an ENERGY STAR Home and its comparison properties when these features were not directly tied to the ENERGY STAR qualification. Although care was taken to avoid such differences, there were groupings in which, for example, an ENERGY STAR Home containing three bedrooms and two full bathrooms was grouped with a property that included three bedrooms and three full bathrooms. Logically, this difference in the number of bathrooms (i.e., 2 versus 3) could drive a price difference between the two homes. In cases like this the third-party appraisal company determined the value of the extra bathroom in the comparison property and then made a corresponding adjustment in its price to account for

this difference. These adjustments provided a quasi-experimental control for home pricing, since not every home was exactly the same in terms of location and features/amenities.

Data Collection

Both sets of data used in Part II of the study were generated from the Triangle MLS database from the years 2009 and 2010. The Triangle MLS contains data on the majority of new homes sold in and around the Raleigh/Durham/Chapel Hill area of North Carolina for the years encompassed by the study and is one of the few such real-estate listing services in North Carolina that indicates whether these homes contain green features or any green building certifications. Both groups comprising the sample contained only data from new construction, single family, detached homes.

ENERGY STAR Homes data set.

The first set of data was generated from all homes listed as ENERGY STAR qualified and that had no other green building certification(s) for 2010 in the Triangle MLS. Homes with ENERGY STAR qualification and additional building certification, like LEED, NAHB, NCHBH, etc., were not considered. The present investigation is interested in the impact of ENERGY STAR qualification alone, and additional investments in homes earning dual or more certifications could mask or otherwise confound the results of the study.

ENERGY STAR Homes were identified in ten separate counties of the Triangle MLS. Only homes from the counties of Wake, Durham, Orange, Chatham, and Johnston were considered for the sample and for subsequent comparable properties. These counties were used because they contained an overwhelming majority of the ENERGY STAR Homes listed by the Triangle MLS (over 94%) and because the ability to find valid comparison properties was considered to be greater than it would have been from the other counties due

to the higher density of home sales in the selected counties. After the five-county region was determined, 100 homes were selected on a proportional, stratified random basis. This procedure was undertaken to ensure that the sample of ENERGY STAR Homes was as representative of the population as possible while still allowing for random selection. Home selection was based on proportionally dividing the sample pool by county and by the size (square footage) of the home. The home size was proportionally stratified based on standard deviation from the population mean home size. Properties were then randomly selected from each category using a randomly assigned identification number and a random number generator. Furthermore, the ENERGY STAR sample had a proportionally similar number of homes from each county and each county contained a proportionally similar stratification of home sizes when compared to the population. These sample and population characteristics are shown graphically in Figures 13 through 16. When examining Figures 13 and 14, note that the general shape and peaks of the frequency distributions approximate each other when comparing population and sampled home square footages. This approximate matching means that the sample accurately captures the prevalent features of the population. When comparing Figures 15 and 16, note that the population percentages to the sampled percentages drawn from each county show numbers that are not an exact match. This inconsistency was due to the sample size and population size difference and to the inability to sample any fraction of an actual home from any particular stratification. In these instances smaller stratifications took priority as larger ones already contained enough homes to justifiably represent their corresponding population subset.

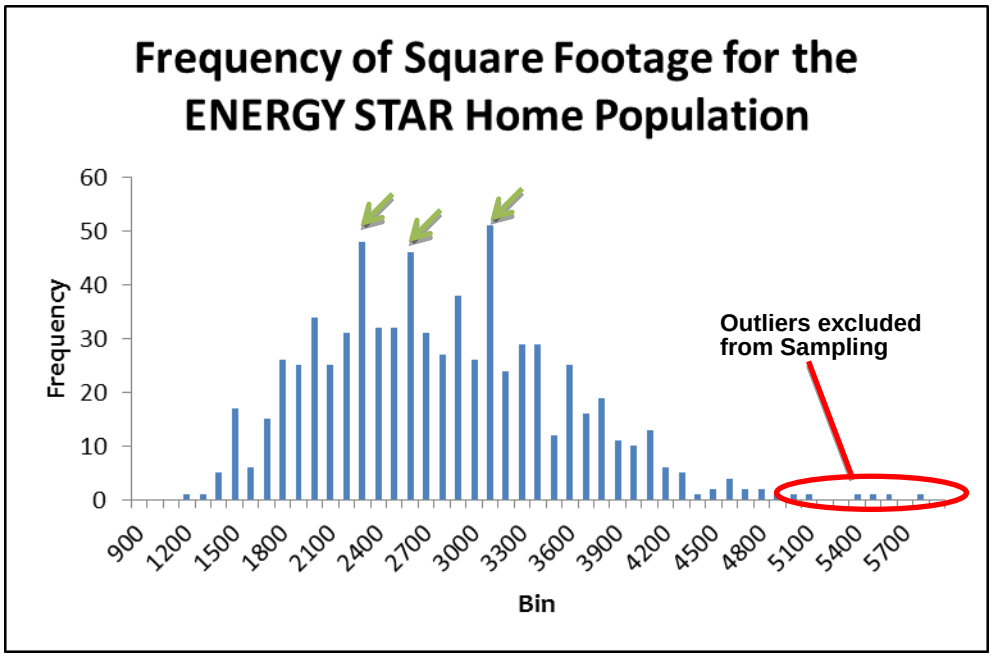

Figure 13. Frequency of square footages of ENERGY STAR Homes in the population from which the sample was drawn.

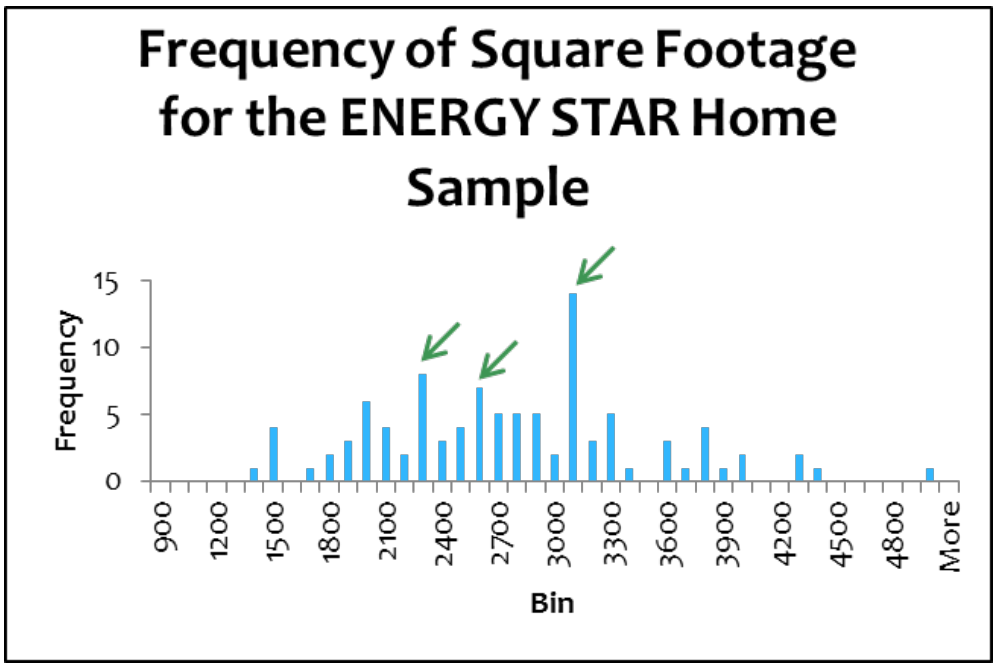

Figure 14. Frequency of square footages of ENERGY STAR Homes in the sampled data set.

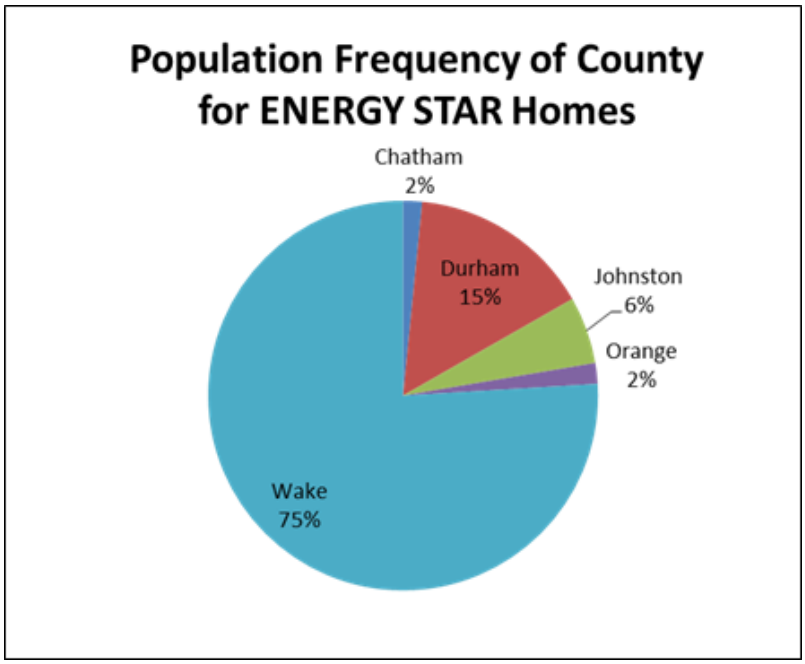

Figure 15. Prevalence of ENERGY STAR Homes in each of the five selected counties as related to the *population* as a whole. Percentages are rounded to the nearest whole number.

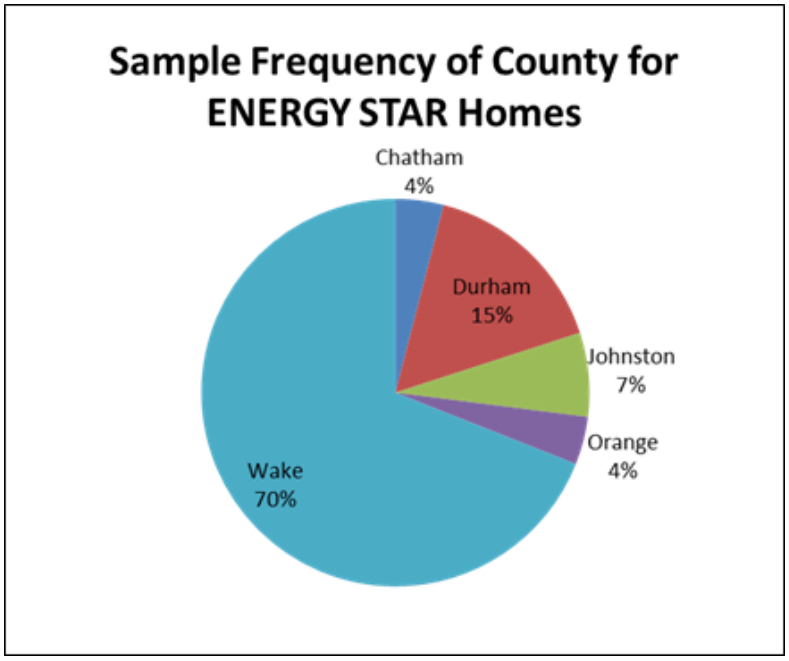

Figure 16. Prevalence of ENERGY STAR Homes in each of the five selected counties as related to the *sample* as a whole. Percentages are rounded to the nearest whole number.

In short, the implemented sample selection method prevented a disproportionally high number of ENERGY STAR Homes that were unrepresentative of the population (three standard deviations from the population mean, for example) from being included in the sample. Likewise, it also prevented a disproportionally high number of homes coming from any one county, and ultimately resulted in a sample that accurately captured the features of its corresponding population.

The importance of having a representative and random sample is paramount. It is easy to imagine the inaccuracies that might arise from a simple random sampling procedure that produces a sample containing too many homes from one particular area. This area could be more affluent and contain homes that are unrepresentatively large in size and high in price. When using data from the Triangle MLS this scenario is likely because the vast majority of sales are found in Wake County, where Raleigh, the state capital of North Carolina, is located, as well as its affluent suburbs. In this area, homes in general tend to have a higher value simply due to location compared to many of the surrounding counties. If simple random selection alone was employed to gather the sample, the likelihood of attaining a sample containing an unrepresentative majority of homes from Wake County would be high, leaving the surrounding areas underrepresented. Inaccuracies like this and other similar complications that could arise from simple random selection might artificially drive the price of ENERGY STAR Homes and was therefore avoided. Concurrently, a simple random sample could adversely impact the accuracy of how long a home spent on the market, making any comparisons less valid or insignificant. For example, a home may sell faster in the state capital than in a rural county adjacent to it. The present investigation uses a proportional

stratified random selection procedure to avoid these inaccuracies and to ensure the most representative sample was generated for comparisons.

Appraisal properties data set.

After the sample of 100 ENERGY STAR Homes was generated, it was sent to a third-party appraiser. Using predefined criteria (discussed later in this section) and standard appraisal industry practices, three comparable properties were generated for each ENERGY STAR Home to create the second data set of 300 code-built homes. A third-party appraisal company was chosen because of its licensed ability to conduct the appraisal process. A licensed appraiser is subject to review, continuing education requirements, and must uphold industry standard practices. Also, access to restricted appraisal industry information is granted to such companies that the researcher could not access.

In general, an appraiser is an industry professional who is responsible for assigning value to property. Often times an appraiser is contracted by the lending institution responsible for financing the construction loan or mortgage for the property. For the purpose of this investigation, the appraisal company was contracted by the researcher. There are federal and state-mandated requirements regarding education, qualifications, and classification for certification of appraisers. Additionally, appraisers must comply with a standardized process for obtaining their license and for maintaining this licensure through continuing education. The procedure for appraising property value contains a set of prescribed and acceptable practices that are relatively standardized. This procedure was developed by Freddie Mac and Fannie Mae, and is called the “Uniform Residential Appraisal Report” (Williams & Ventolo, 1994).

Appraisers can choose between three methods of appraising a home: the cost approach, the income approach, and the comparison approach (National Association of Home Builders Research Center, Inc., 2005). Generally the most common appraisal approach concerning residential property is the comparison approach. This approach was the one employed by the third-party appraisal company in the current investigation. In this approach, the subject property is compared to homes thought to be similar or the same along several dimensions (Mitchell, Bloise, & Matthews, 2010). These comparable properties are generally close in geographic location to the subject property and have sold within a similar time frame, usually within six months before the subject property. This time frame is adjusted depending on the housing market such that the comparable properties have sold within the closest possible time to eliminate any pricing variances due to changes in the economic climate. After a number of comparable properties are chosen (usually at least three comparables are generated for each subject property), adjustments for inequities between the subject property and its comparison properties are made. These adjustments are made to the comparison property's sale price to better reflect what the home would have cost if it were as similar to the subject property as possible. Once the adjustments are in place, the comparable home prices are averaged to create the appraisal value of the subject property.

Predefined criteria furnished by the researcher were also followed by the appraisal company and were created to ensure comparison properties were suitable beyond the findings from standard appraisal practices. These ten additional guidelines were developed so that comparison properties would be as similar to their ENERGY STAR counterparts as possible. Ensuring the highest degree of similarity between ENERGY STAR Homes and their comparables was essential for determining if the ENERGY STAR label and its related

efficiency increases had a significant impact on a home's marketability. However, because the need for simply attaining comparison homes outweighed the importance of exactly following these ten guidelines, exceptions to the guidelines were allowed only when acquiring three comparison properties would not otherwise have been possible. In an experimental setting these problems would be controlled for, but because the present study examined real world data, it was not always possible to find perfect comparison properties that always followed every guideline. This compromise is discussed in the section titled "Limitations of the Study" in Chapter 1. The ten selection guidelines that were used in conjunction with standard appraisal industry practices are discussed in terms of the subject property (the ENERGY STAR Home) and its comparison properties (comps), and included the following:

1.) The comp should not be chosen or otherwise influenced on the basis of the subject property's sale price. Comps should be chosen because they are of similar construction, location, date sold, number of rooms (bed and baths), garage, property size, etc. The study will determine if sale price is affected by ENERGY STAR qualification, so every possible effort needs to be made to select homes that are as similar as possible to the subject property without matching them along the dimension of price. The NCEEA researcher will statistically examine differences in sales impact.

2.) Comps need to have adjustments that control for all known inequities between them and the subject property. Because sales price differences are of interest, it is important that the comp home sale price be adjusted for features not shared with the subject property to gain as accurate an estimate of price as possible. These

adjustments should be made in accordance with standard practices implemented by appraisal professionals.

3.) Comps should have no green certifications. In addition, comps ideally will not have any distinguishing or uncommon green features (like a photovoltaic system or solar thermal system). If they do, an appropriate value adjustment should be made. Common inexpensive green features (low VOC paint, formaldehyde-free insulation, etc.) will be allowed on comps.

4.) Comps should be within +/- 10% of the subject property's size (conditioned sq. ft.).

5.) Comps should bracket the subject property in data categories where applicable and if possible. Comps should NOT bracket the subject property for sale price; this variable should not be considered.

6.) Comps should have a similar quality of construction and similar aesthetic design (the way they are built and the finishes and materials used inside and outside).

7.) Comps should be located in the same geographic area or a similar area as the subject property. If significant inequities exist in geographic location, an adjustment should be made based on best appraisal practices.

8.) Comps should have sold within no more than +/- three months of the subject property. Exceptions to this guideline can only be made when no suitable comparison has been sold within the three month window.

9.) Comps will only be new homes sales.

10.) Each subject property is required to have three (3) unique comps.

Data Analysis Procedures

Data were analyzed using paired-sample *t*-tests to determine if any significant differences existed between the ENERGY STAR Homes and the code-built comp homes. This metric examined whether the two groups' means were statistically different from one another with statistical certainty. A paired-sample *t*-test was selected because the code-built comp homes were matched to the ENERGY STAR Homes on a number of dimensions such that they were as similar as possible without having any known building certification. Furthermore, the code-built homes were selected specifically for comparison to each of the ENERGY STAR Homes as part of the appraisal process, not randomly. Having equal sample sizes is necessary to perform a paired-sample *t*-test. To accomplish equal sample sizes the three comp home data points generated for each ENERGY STAR Home were averaged to create one aggregate composite data point. Additionally, the *t*-test was used because of its robust nature when considering inferences about group means, even if the data being examined are nonparametric in nature (Rasch & Guiard, 2004). Results will be discussed in terms similar to the precedent set by Dixon, Abdel-Salam, and Kauffmann (2010) indicating the highest attained level of statistical significance as demonstrated by the *t*-test *p*-value. Subsequent analysis of data gathered through the use of histogram and frequency distribution analysis for the present investigation revealed the data to be sufficiently normal.

Randomized Sample Comparison of ENERGY STAR Homes Results and Discussion

Data analyses were carried out on a number of variables and the results and subsequent discussion are given below. The groups being compared were ENERGY STAR Homes and the aggregate composite scores for the code-built comp homes. Group means

were compared on a number of different dimensions to determine if ENERGY STAR qualified homes held a significant market advantage over non-qualified homes. Group means were analyzed for differences in: (a) sale price; (b) sale price to list price ratio (i.e., the percentage of the listing price the home sold for); (c) price per square foot, and (d) number of days spent on market. Frequency distributions, a number of descriptive statistics, *t*-test values, and the actual *p*-values for each *t*-test are given for each group and variable of interest.

Sales Price Analysis

The data regarding a home's sale price was examined using three distinct approaches. A home's sale price is a good indicator of market performance because it demonstrates what consumers are willing to pay for a product, in this case homes that are either ENERGY STAR qualified or not. The first approach looks at an ENERGY STAR Home's sale price and compares it to the code-built comp homes' sale price. The sale price data was generated from the data field on the MLS datasheets labeled "sale price" and was the recorded price the home sold for. The second approach took into consideration any financial concessions that were made to home buyers at the time of sale and removed these concessions from the reported sale price. It is not uncommon for builders to sell a home at or close to its list price while offering the buyer some type of financial concession at the time of closing. Thus, examining sale price with any financial concessions removed is a more accurate way of judging a home's true sale price as reflected by the total cost to the home buyer. The final approach considers both financial concessions and adjustments made to code-built comp homes' sale prices determined by the third-party appraisal company to account for inequities between them and their subject ENERGY STAR properties. These adjustments were made in

order to make the properties as similar to each other as possible using established appraisal industry standards. This comparison is of the highest interest because it demonstrates the most tightly controlled conditions, minimizing the degree of difference between the two groups. It is important to note that adjustments both increased and decreased code-built comp home prices and were not biased in either direction.

When examining the data comparing reported sale prices, ENERGY STAR Homes (M = \$339,360, SD = \$147,002) were found to sell for statistically significantly more than code-built comp homes (M = \$335,103, SD = \$139,949), t (199) = 1.47, $p < .10$ ($p = 0.0717$). ENERGY STAR Homes (M = \$337,106, SD = \$147,997) also sold for statistically significantly more than code-built comp homes (M = \$332,597, SD = \$140,656) when financial concessions were removed from the sale prices, t (199) = 1.52, $p < .10$ ($p = 0.0660$). Finally, ENERGY STAR Homes (M = \$337,106, SD = \$147,992) sold for statistically significantly more than code-built comp homes (M = \$331,539, SD = \$142,306) when financial concessions were removed from the sale prices and adjustments were made to the code-built comp home prices to account for inequities between their corresponding ENERGY STAR subject property, t (199) = 1.18, $p < .05$ ($p = 0.0154$). Results of the analyses, their distributions, and the distribution of sale price differences are shown in Figures 17 through 23. A summary of group means, standard deviations, mean differences, and t-test results including significance level and p-values can be found in Table 6.

Table 6. *Sale Price Analysis Statistics Including Group Means, Standard Deviations, Group Mean Differences, and* t*-test Results Including Significance Level and* p*-values, by Analysis Type*

Sale Price Analysis Statistics					
Group	**Mean**	**Standard Deviation**	**Mean Difference**	***p*-value**	**Level of Significance (Alpha Level)**
Sale Price Analysis:					
ENERGY STAR Homes	$339,360	$147,002	$4,258	0.0717	0.10
Code-Built Comp Homes	$335,103	$139,949			
Analysis w/ Financial Concessions Removed;					
ENERGY STAR Homes	$337,106	$147,992	$4,509	0.0660	0.10
Code-Built Comp Homes	$332,597	$140,656			
Analysis w/ Financial Concessions Removed and Adjustments:					
ENERGY STAR Homes	$337,106	$147,992	$5,566	0.0154	0.05
Code-Built Comp Homes	$331,539	$142,306			

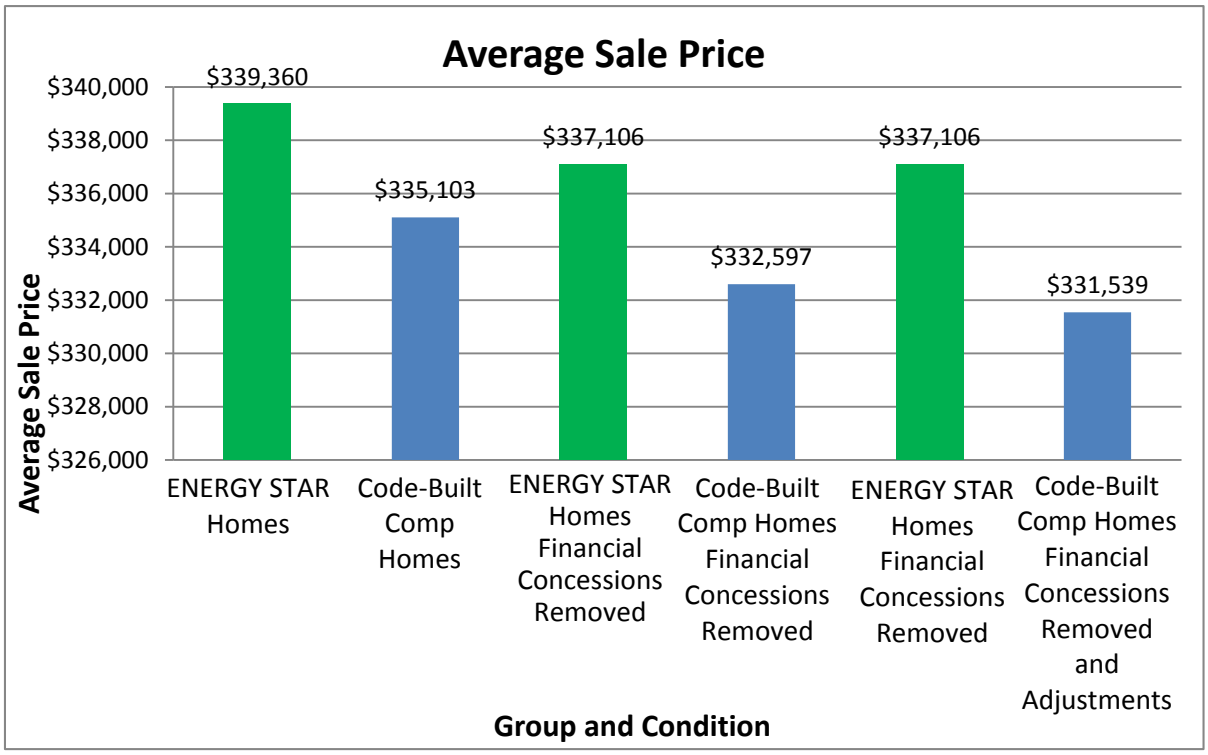

Figure 17. Group mean comparison for sale price data for all three analytic approaches.

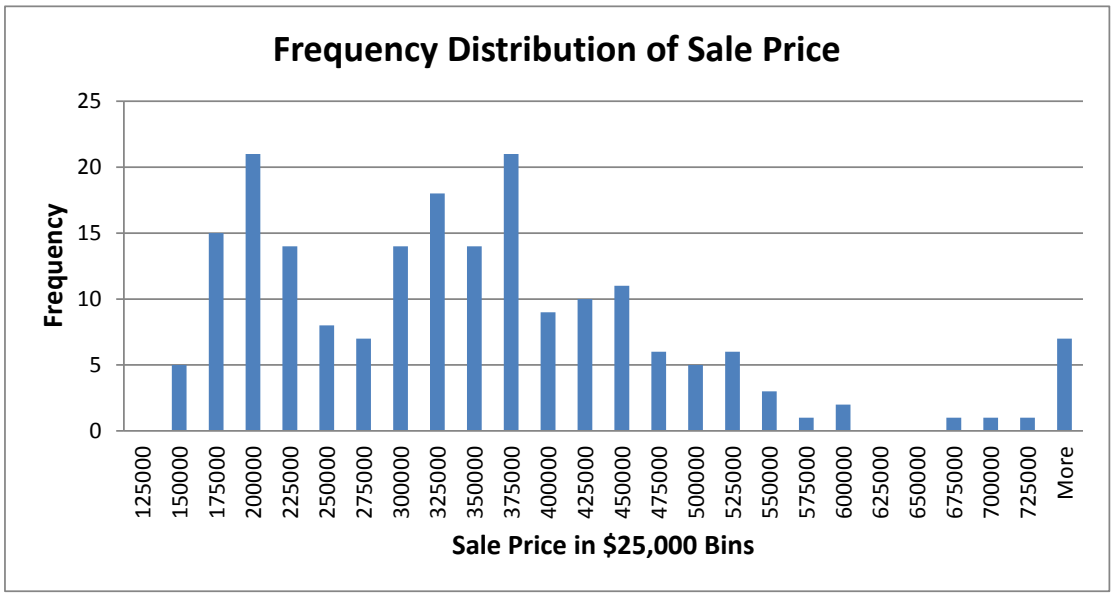

Figure 18. Frequency distribution of sale prices of ENERGY STAR and code-built homes combined, in $25,000 increments.

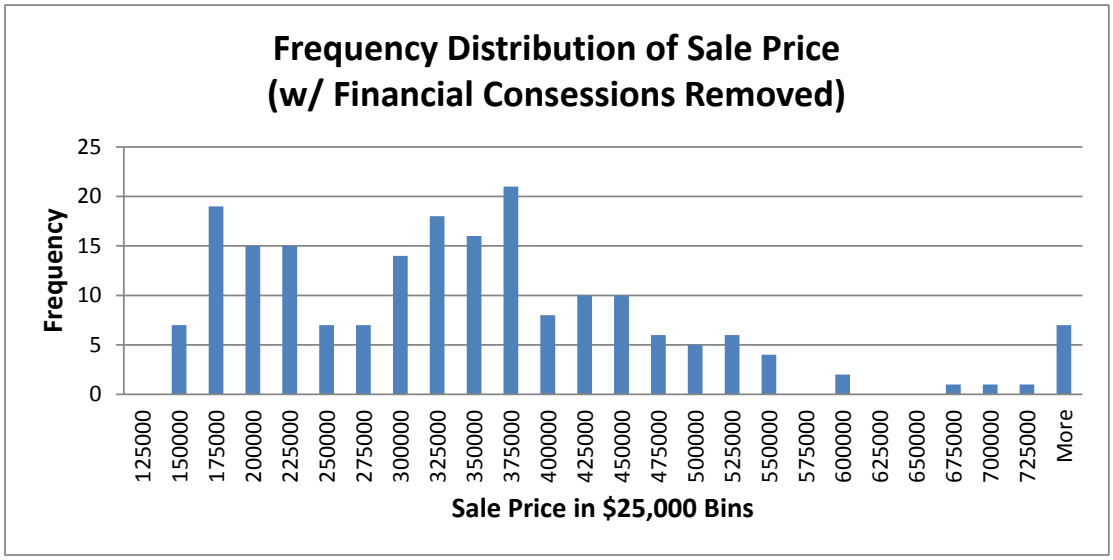

Figure 19. Frequency distribution of sale prices after financial concessions are removed of ENERGY STAR and code-built homes combined, in $25,000 increments.

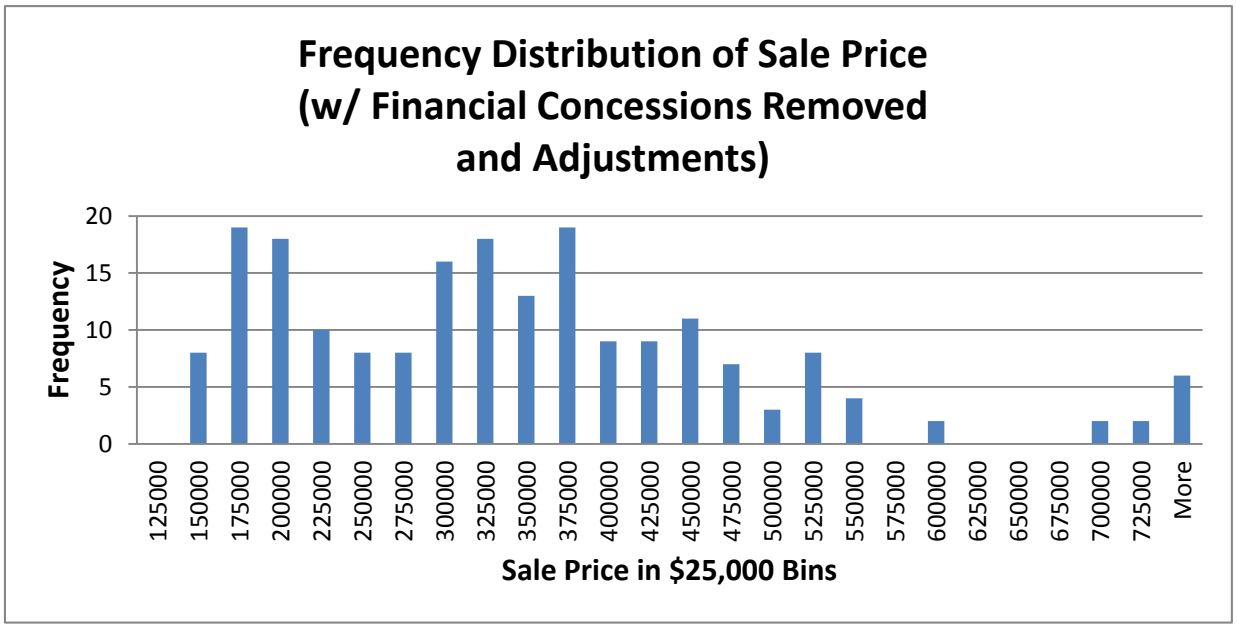

Figure 20. Frequency distribution of sale prices after financial concessions are removed and financial adjustments are accounted for of ENERGY STAR and code-built homes combined, in $25,000 increments.

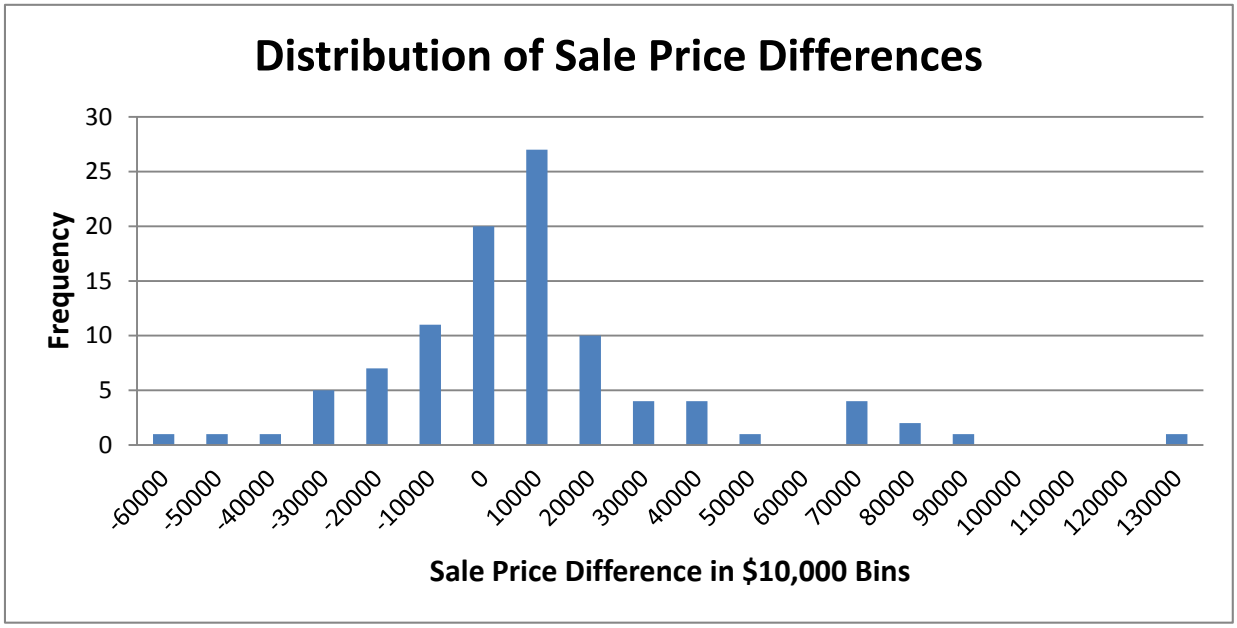

Figure 21. Frequency distribution of sale price differences between ENERGY STAR Homes and code-built comp homes, in $10,000 increments.

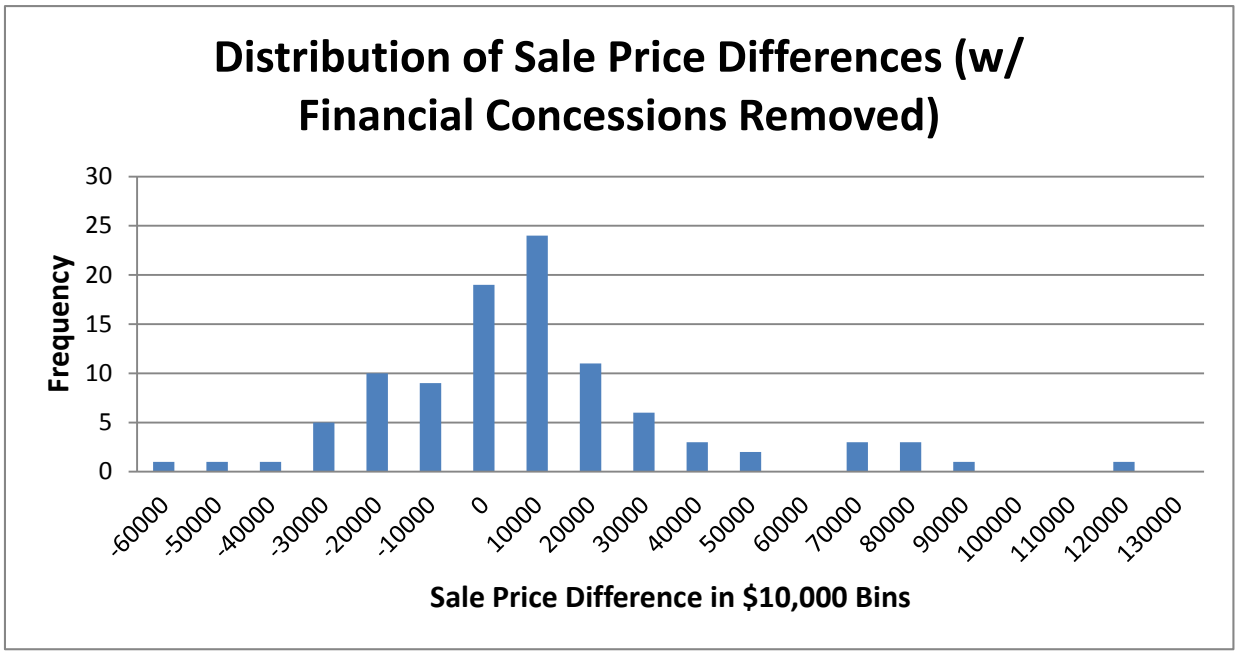

Figure 22. Frequency distribution of sale price differences between ENERGY STAR and code-built homes after financial concessions are removed, in $10,000 increments.

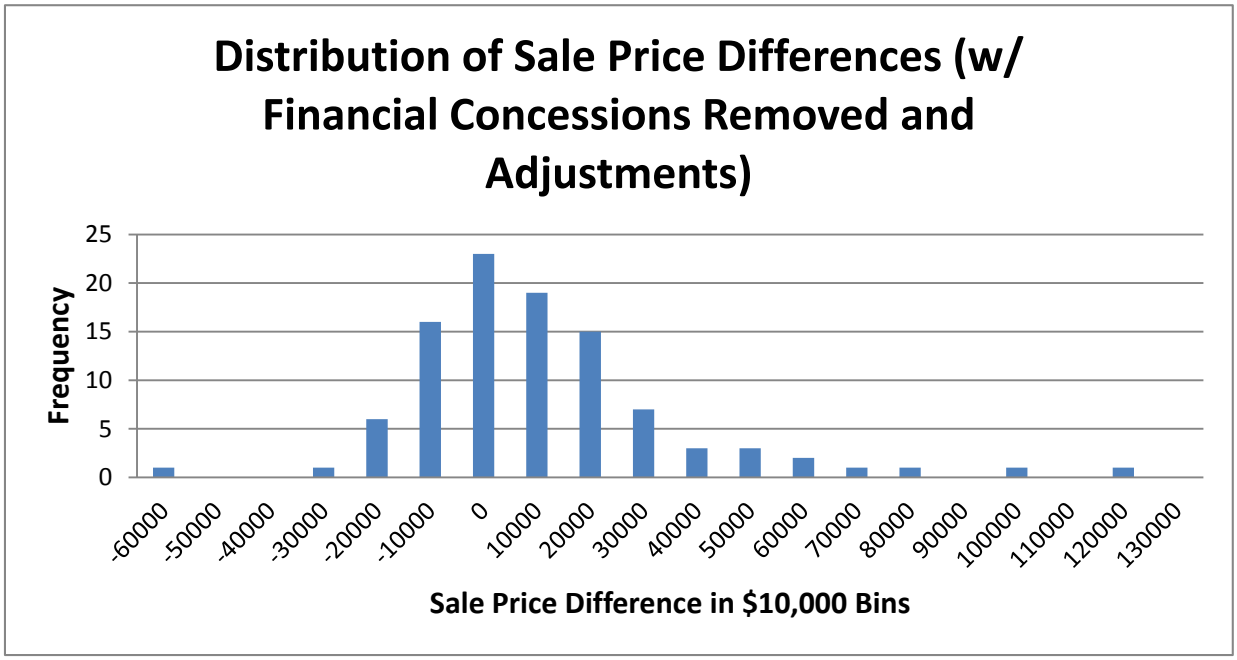

Figure 23. Frequency distribution of sale price differences between ENERGY STAR and code-built homes after financial concessions are removed and financial adjustments are accounted for, in $10,000 increments.

These findings strongly indicate that ENERGY STAR qualified homes sell for more than code-built homes that are similar in construction and location. Significant group differences were found regardless of the approach used to analyze the data. Expectedly, the strongest finding was exhibited when using the approach that minimized differences between the code-built comp homes and their ENERGY STAR subject properties. This analysis represents the closest “apples-to-apples” comparison and reached the highest level of significance. Findings indicate that it can be expected that an ENERGY STAR Home will sell for more than a comparable code-built home in a market similar to the one sampled herein. The data from the sample indicate that ENERGY STAR Homes sold for an average of $5,566 more than the code-built comp homes when the differences between the homes were minimized. This difference is large enough to suggest that costs associated with ENERGY STAR qualification, on average, can be recovered by builders at the time of sale. Additionally, this finding illustrates that the value of an energy-efficient home reflected by its sales price is greater than those simply built to code, providing solid evidence for the appraisal industry to assign value to energy-efficient home features, including ENERGY STAR qualification.

Proportion of List Price Analysis

Two different approaches were used to analyze the data surrounding how much of the list price a home sold for. The first approach used reported sales price data and divided it by the home’s initial list price. The second approach considered financial concessions, removing them from the sale price, and then divided this new sale price by the original list price. Using the adjusted code-built comp home prices to conduct a third analysis of proportion of the list price was not used. This analysis would be inappropriate because an adjusted sale price

would be compared to a list price that had not undergone similar adjustments, thus distorting the relationship between sale price and list price.

When examining the sale price-to-list price ratio at which homes sold, ENERGY STAR Homes (M = 98.61%, SD = 3.56%) were found to have sold for a greater percentage of the list price compared to code-built comp homes (M = 98.17%, SD = 2.51%), but this result failed to reach statistical significance, t (199) = 1.06, p = n.s. (p = .1463). ENERGY STAR Homes were found to sell for 0.45% more of their list price compared to the code-built comp homes, but this difference was not great enough to produce a significant result. Similarly, when considering the proportion of the list price at which homes sold when financial concessions were removed, ENERGY STAR Homes (M = 97.69%, SD = 3.80%) achieved a greater percentage compared to code-built comp homes (M = 97.21%, SD = 2.61%), but this result also failed to reach statistical significance, t (199) = 1.10, p = n.s. (p = .1362). Using this approach, ENERGY STAR Homes were found to sell for 0.48% more of their list price compared to the code-built comp homes. Results of the analyses, their distributions, and the distribution of sale price differences are shown in Figures 24 through 26. A summary of group means, standard deviations, mean differences, and t-test results, including significance level and p-values, can be found in Table 7.

Table 7. *Proportion of List Price Statistics, Including Group Means, Standard Deviations, Group Mean Differences, and* t*-test Results, by Type of Analysis*

Proportion of List Price Analyses Statistics					
Group	**Mean**	**Standard Deviation**	**Mean Difference**	***p*-value**	**Level of Significance (Alpha Level)**
Proportion of List Price Analysis:					
ENERGY STAR Homes	98.61%	3.56%	0.45%	0.1463	Not significant
Code-Built Comp Homes	98.17%	2.51%			
Analysis w/ Financial Concessions Removed:					
ENERGY STAR Homes	97.69%	3.56%	0.48%	0.1362	Not significant
Code-Built Comp Homes	97.21%	2.61%			

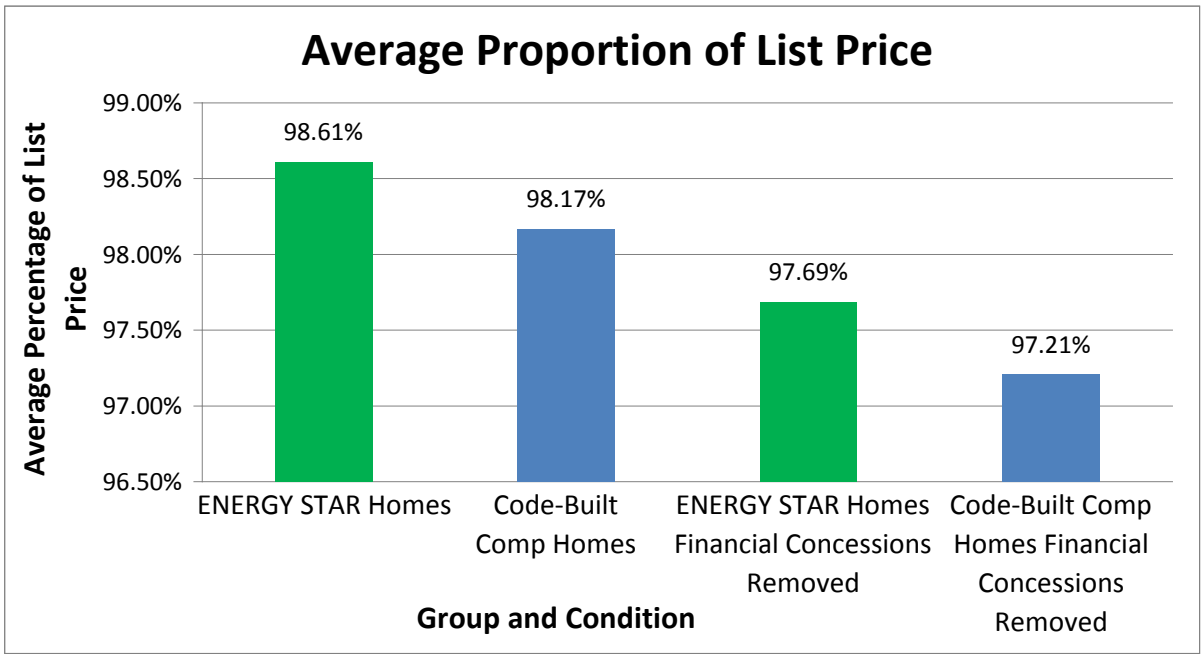

Figure 24. Group means of the proportion of list price for ENERGY STAR and code-built homes, by group and condition.

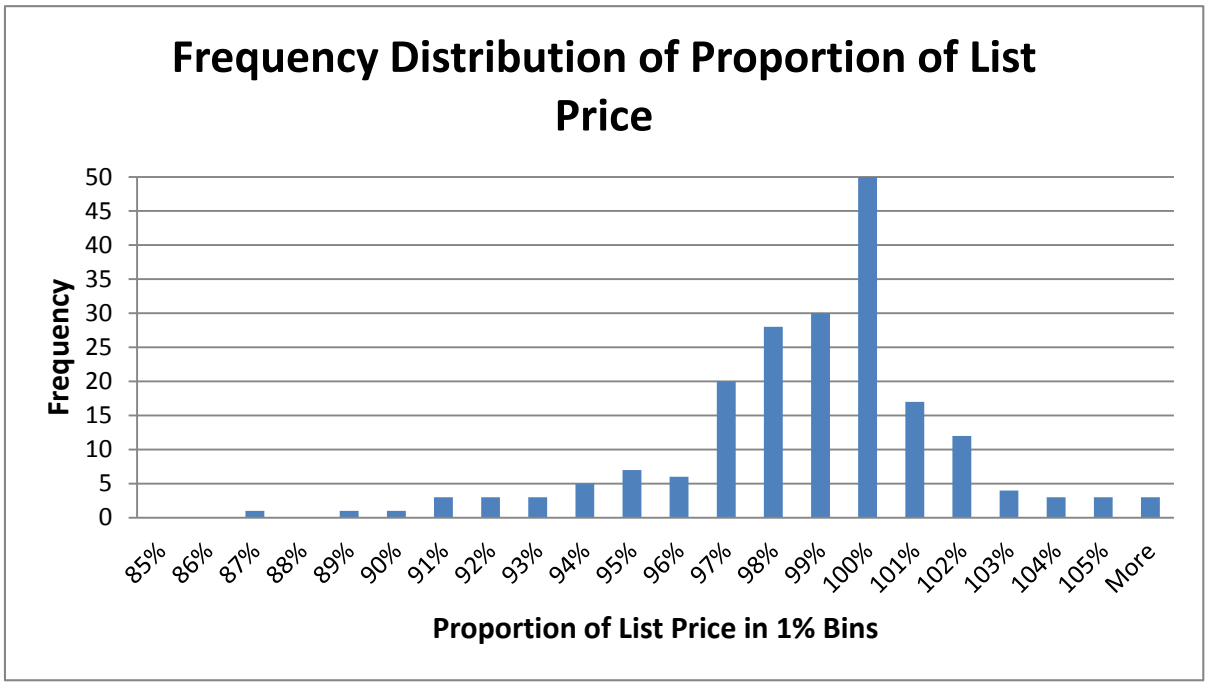

Figure 25. Frequency distribution of the proportion of list price at which ENERGY STAR and code-built homes sold, in 1% increments.

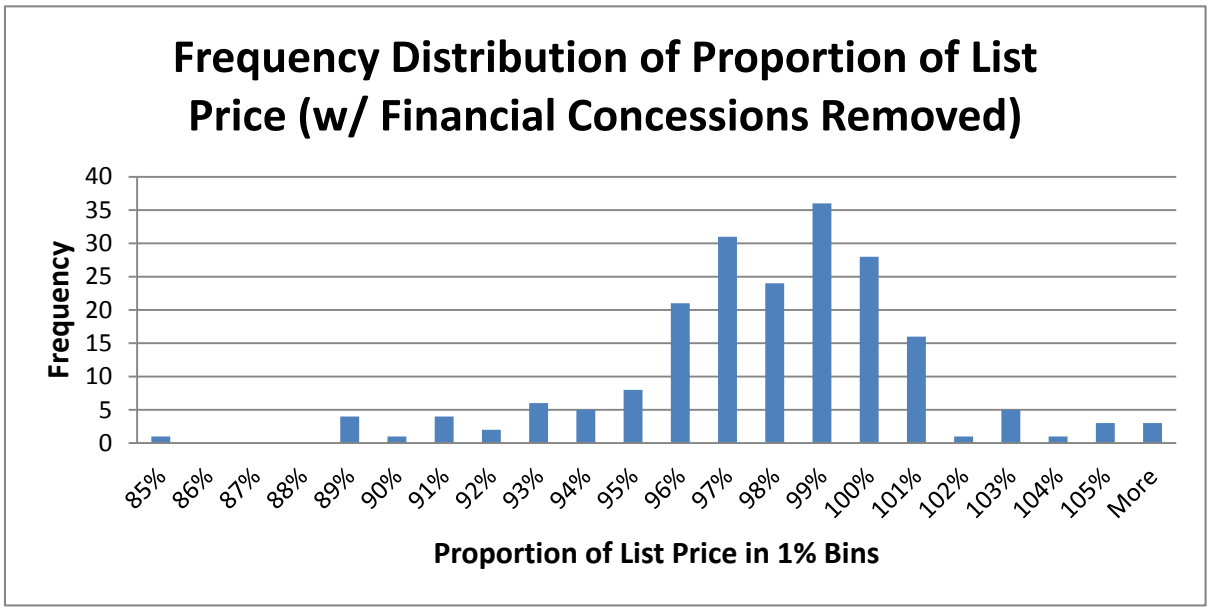

Figure 26. Frequency distribution of the proportion of list price at which ENERGY STAR and code-built homes sold, after financial concession were removed, in 1% increments.

The data on proportion of list price suggests that while ENERGY STAR Homes were observed to sell for a higher proportion of their list price, this difference is not great enough to reach statistical significance. However, these results did approach significance with *p*-values only a few hundredths of a percent away from statistical significance. This lack of statistical evidence could be occurring for several reasons. Mathematically, there may not be enough statistical power to generate a significant result, which could be due to limitations in the sample size. Additionally, these homes may be priced very close to market value such that there is little room for concessions that could yield larger differences between the list price and sale price. This instance may be especially true in today's economic climate with a depressed housing market. In such a market, home builders may price homes to sell, minimizing profit margins and subsequent negotiating room on the sale price.

Other notable findings were revealed by analyzing sale price data. If an ENERGY STAR Home's list price was set above that of a similar non-certified home by the

demonstrated sale price premium of $5,566, then no difference in the proportion of the list price would be expected. Put another way, ENERGY STAR Homes may have the additional cost of ENERGY STAR qualification absorbed by a listing price increase. However, an analysis of home list prices revealed only moderate, non-statistically significant differences in the list prices of ENERGY STAR Homes (M = $344,219, SD = $148,855) and the code-built comp homes (M = $341,858, SD = $144,575), t (199) = 0.8371, p = n.s. (p = 0.2018). This finding means that ENERGY STAR Homes are not necessarily priced above similar code-built homes and the sale price premium is not indicative of a list price increase.

Home buyers may not understand the energy savings and other benefits encompassed by an ENERGY STAR Home. Seemingly, home buyers are willing to pay a slightly higher, statistically insignificant amount of the list price. The fact that a difference was observed at all may reflect a small percentage of home buyers that actively sought and were willing to pay more for efficient housing. However, this statistically insignificant difference most likely reflects the fact that most consumers view an ENERGY STAR Home as the same product as a non-certified home and are therefore willing to pay approximately the same percentage of the listing price for any home. Future research should be developed targeting consumer comprehension of the economic benefits of ENERGY STAR qualification over the span of a 30-year mortgage and their willingness to pay for energy efficiency. Research along these lines would provide greater insight into possible reasons why ENERGY STAR Homes did not sell for a statistically significant greater proportion of their list price compared to the code-built comp homes.

Price per Square Foot Analysis

The price per square foot of a home is calculated by dividing a home's sale price by its reported conditioned square footage. Understanding the value of a home on a price per square foot basis is important because it creates a standard unit of measurement that can be equally applied to any home. Examining only the sale price of a home is helpful, but cannot accomplish a universal unit that defines how the price was reached. Although the study tried to control for inequities between home sizes, it is often the case that an ENERGY STAR Home is compared to homes that are not the exact same square footage. In this instance the size differences could drive differences in home prices because it would logically follow that a larger home requiring more time and material would cost more. Financial adjustments were made on the basis of size inequities between the subject and comparison properties, but this difference may not cover the full amount a particular builder may charge for a home on a per square foot basis. Therefore, a methodological approach to examine home sales price employing a standard unit was necessary. The analysis of price per square foot employed three approaches similar to those used to analyze data regarding sale price. The price per square foot was calculated for basic sale price data, sale price data after any financial concessions were removed, and sale price data with a combination of removing financial concessions and taking into account adjustments made to the code-built comp homes to minimize differences between them and their ENERGY STAR subject properties. Again, this latter analysis is the most important because it represents the most "apples-to-apples" comparison.

When examining the price per square foot for sale price data, ENERGY STAR Homes (M = \$121.81, SD = \$29.97) were found to sell for statistically significantly more

than code-built comp homes (M = \$119.25, SD = \$23.59), t (199) =, $p < .05$ (p = 0.0350). ENERGY STAR Homes (M = \$120.85, SD = \$30.49) also sold for statistically significantly more than code-built comp homes (M = \$118.23, SD = \$24.06) when financial concessions were removed from the sale prices, t (199) =, $p < .05$ (p = 0.0337). Finally, ENERGY STAR Homes (M = \$120.85, SD = \$30.49) sold for statistically significantly more than code-built comp homes (M = \$117.86, SD = \$24.46) when financial concessions were removed from the sale prices and adjustments were made to the code-built comp home prices to account for inequities between them and their corresponding ENERGY STAR subject properties, t (199) =, $p < .05$ (p = 0.0129). Results of the analyses as well as their distributions are shown in Figures 8 through 11. Results of the analyses, their distributions, and the distribution of sale price differences are shown in Figures 27 through 33. A summary of group means, standard deviations, mean differences, and *t*-test results including significance level and *p*-values, can be found in Table 8.

Table 8. *Price Per Square Foot Statistics, Including Group Means, Standard Deviations, Group Mean Differences, and* t*-test Results, Including Significance Level and* p*-values by Analysis Type*

Price per Square Foot Analyses Statistics					
Group	**Mean**	**Standard Deviation**	**Mean Difference**	***p*-value**	**Level of Significance (Alpha Level)**
Price per Square Foot Analysis:					
ENERGY STAR Homes	\$121.81	\$29.97	\$2.56	0.0350	0.05
Code-Built Comp Homes	\$119.25	\$23.59			
Analysis w/ Financial Concessions Removed;					
ENERGY STAR Homes	\$120.85	\$30.49	\$2.62	0.0337	0.05
Code-Built Comp Homes	\$118.23	\$24.06			
Analysis w/ Financial Concessions Removed and Adjustments:					
ENERGY STAR Homes	\$120.85	\$30.49	\$2.99	0.0129	0.05
Code-Built Comp Homes	\$117.86	\$24.46			

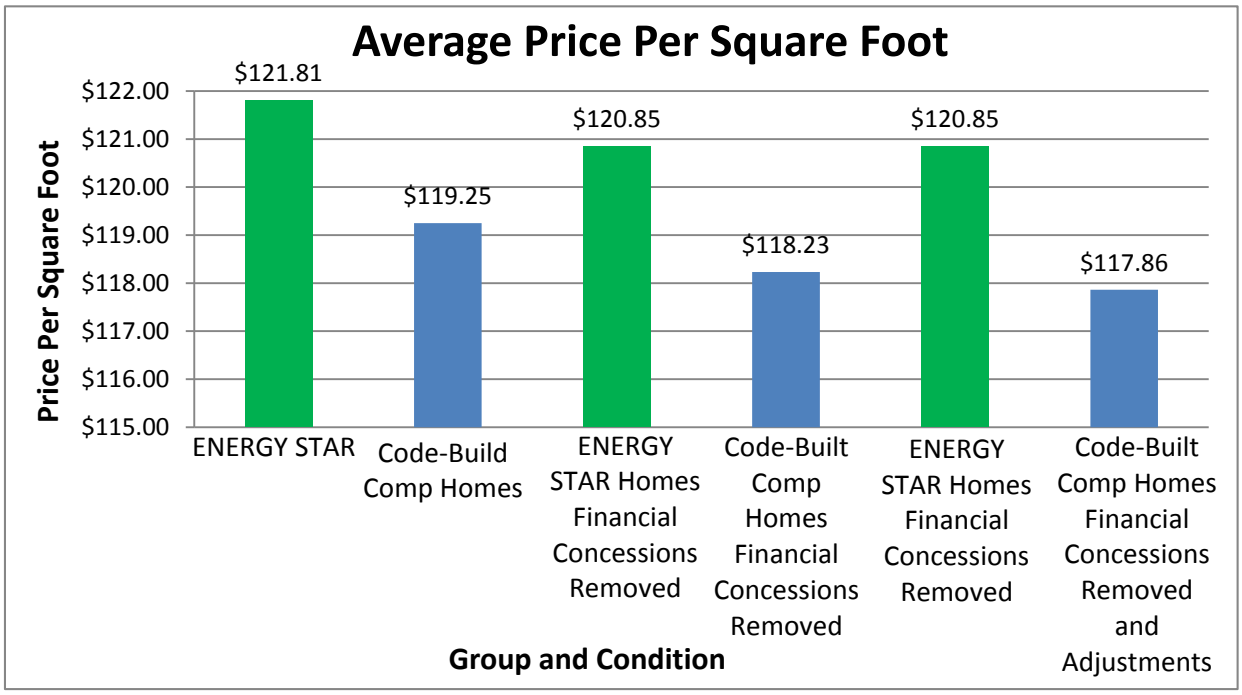

Figure 27. Group mean comparison for price per square foot data for all three analytic approaches.

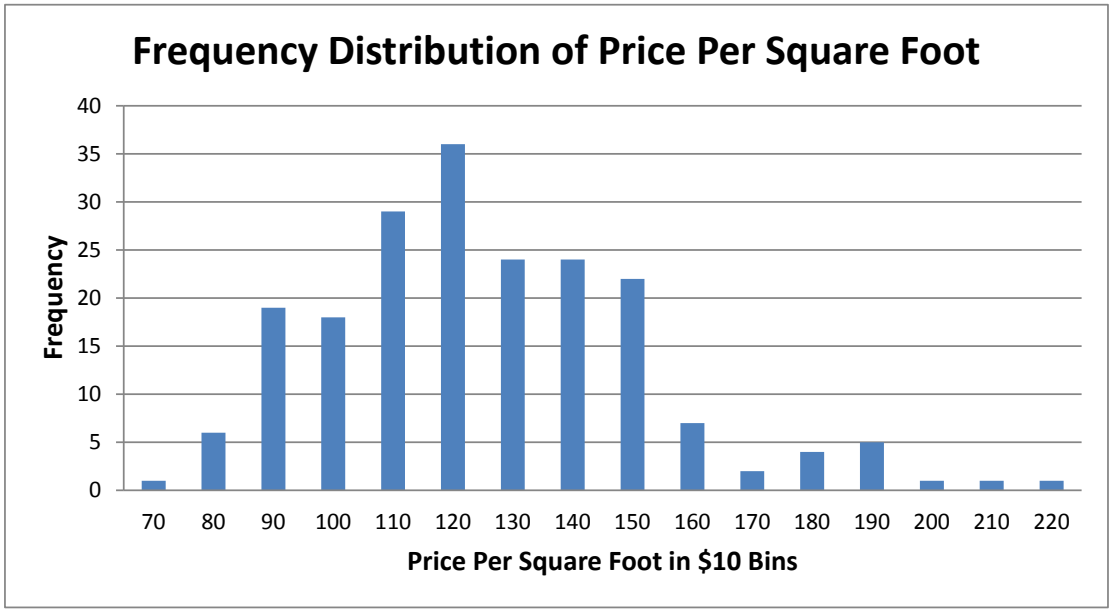

Figure 28. Frequency distribution of price per square foot of ENERGY STAR and code-built homes, in bins of $10.

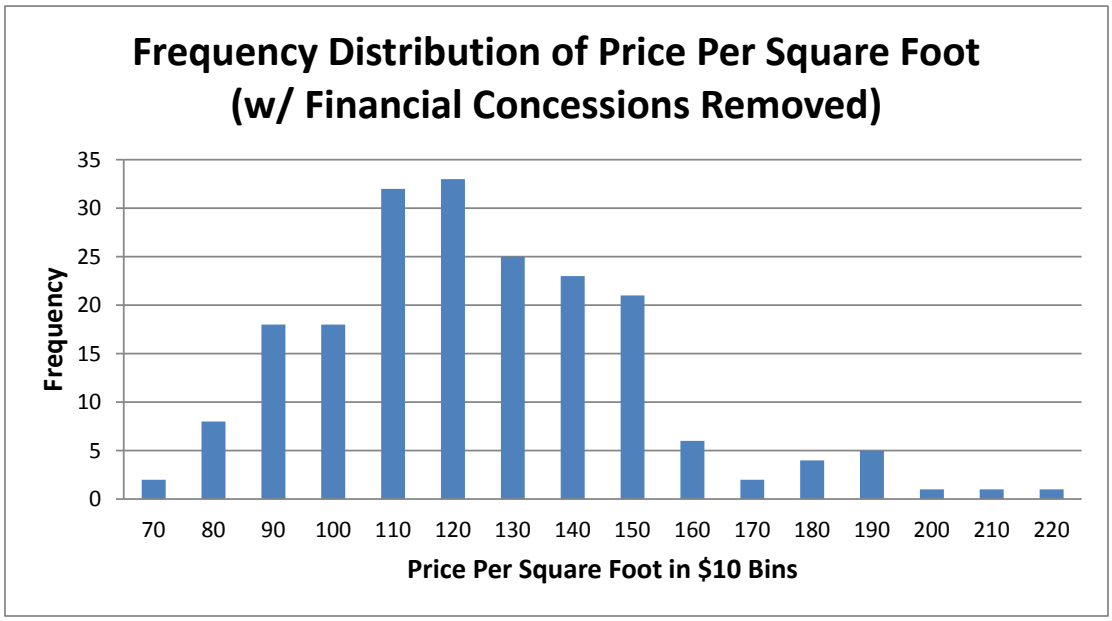

Figure 29. Frequency distribution of the price per square foot that ENERGY STAR and code-built homes sold for after financial concessions were removed, in bins of $10.

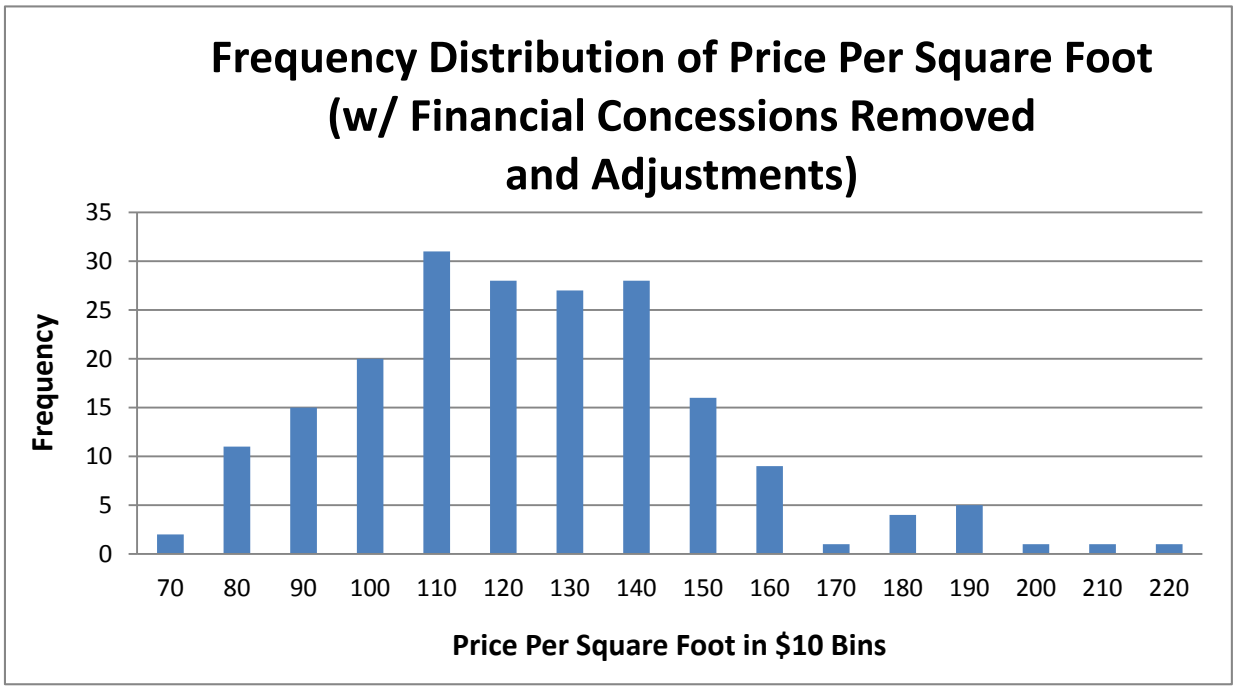

Figure 30. Frequency distribution of the price per square foot that ENERGY STAR and code-built homes sold for after financial concession were removed and adjustments were considered, in bins of $10.

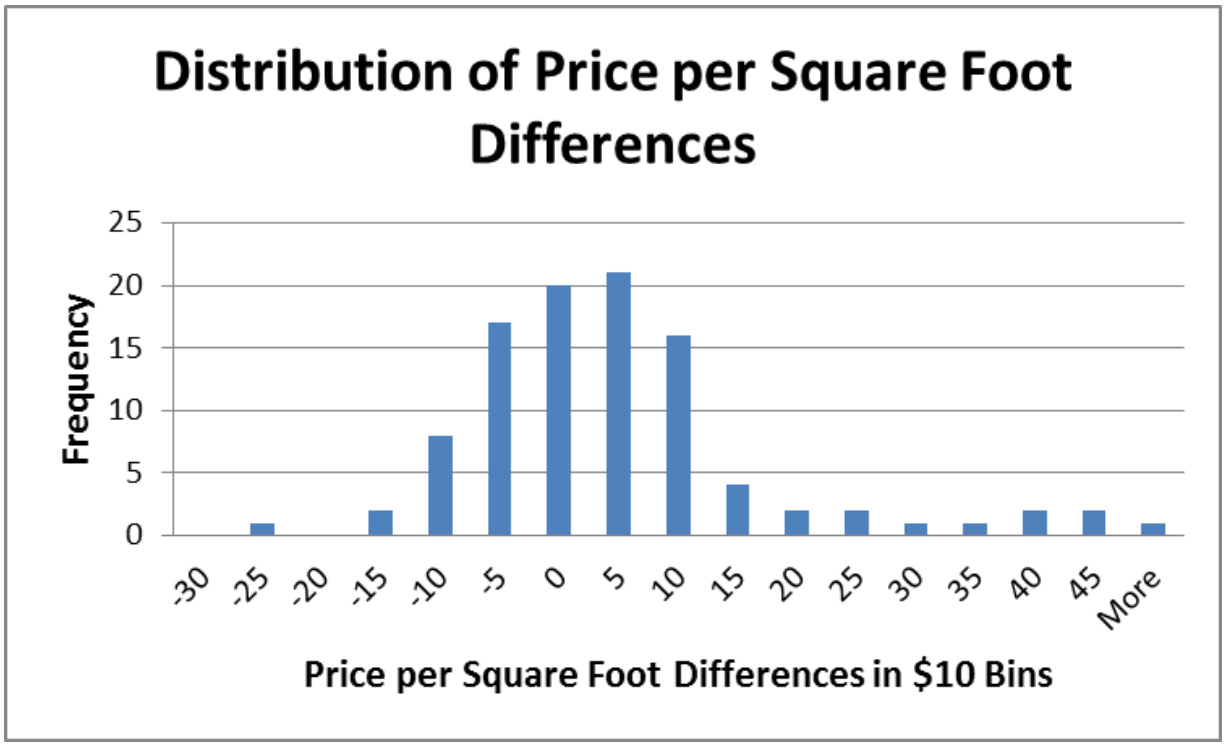

Figure 31. Frequency distribution of price per square foot differences between ENERGY STAR Homes and code-built comp homes, in $5 increments.

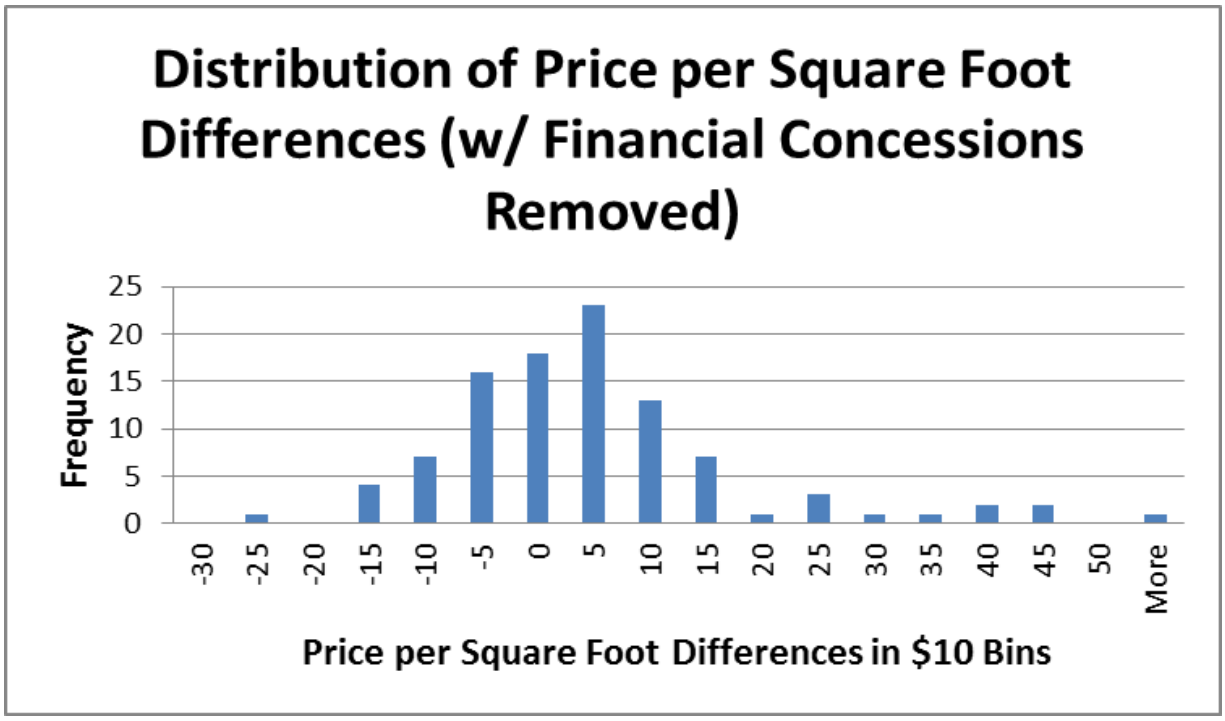

Figure 32. Frequency distribution of price per square foot differences between ENERGY STAR and code-built homes after financial concessions are removed in $5 increments.

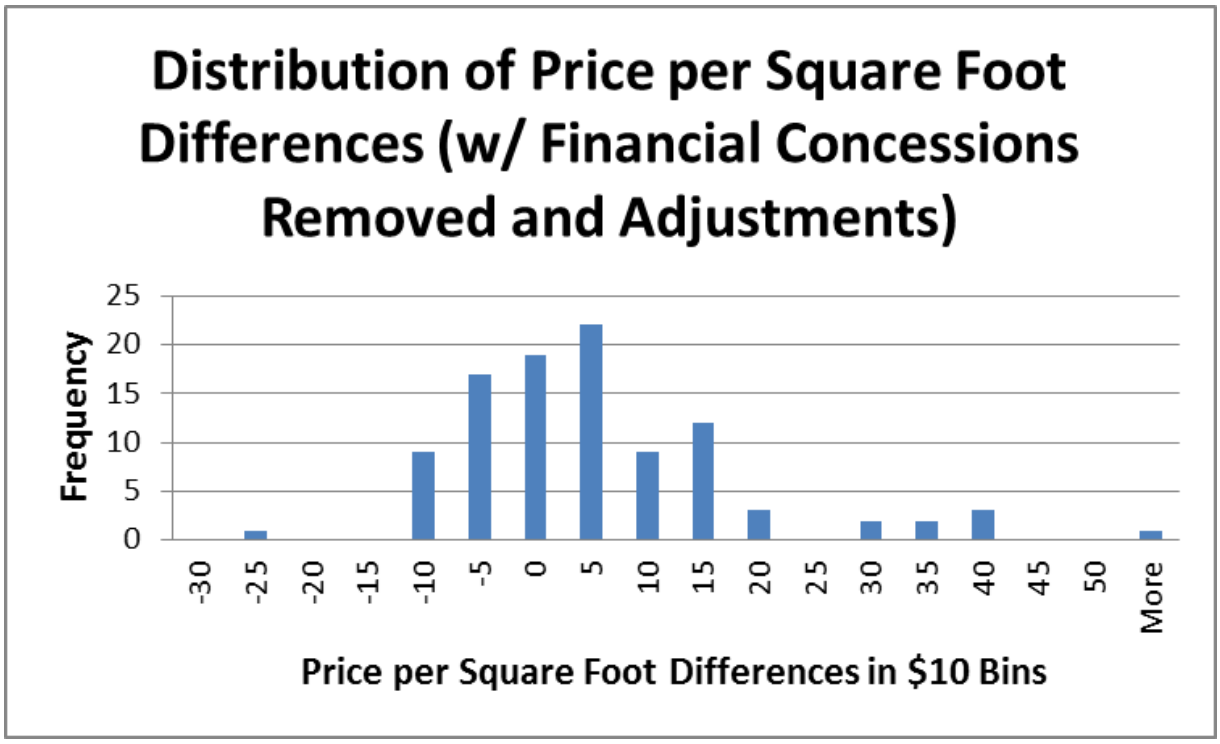

Figure 33. Frequency distribution of price per square foot differences between ENERGY STAR and code-built homes after financial concessions are removed and financial adjustments are accounted for, in $5.00 increments.

The analyses regarding price per square foot revealed strong evidence indicating ENERGY STAR Homes encompass a significant market advantage over similar code-built homes. These results largely followed the trends uncovered when examining the sale price data, but yielded even stronger evidence due to the use of a universal unit measuring price. Again, the strongest finding was the analysis completed where the differences between ENERGY STAR Homes and the code-built comp homes were minimized. This analysis took into consideration both the financial concessions and the adjustments made by the third-party appraiser. When examining the data in this way, the data yielded results approaching the $p < 0.01$ significance level and indicated the average ENERGY STAR Home from the sample sold for nearly $3.00 more per square foot than a code-built comp home. Since ENERGY

STAR qualification represents a modest additional investment, typically between 0.5%-1.5% (depending on economies of scale) of its retail value, there is a strong likelihood of recovering initial investment and even increasing profit margins for the builder.

Days on Market Analysis

The data concerning the number of days a home spent on the market originates from a data field contained within the MLS datasheets. It is important to note that the MLS datasheets contain two distinct data fields pertaining to the days a home spends on the market. Only one is examined by the study. The first data field pertains to the days a home has spent on the market for its most current listing. The second includes a cumulative count of the days a home has spent on the market for its current listing, in addition to any previous listings that particular home may have had. Often, if a home has spent a relatively long period of time on the market, the buyer may choose to switch real estate agents or pull the home from the market and relist it later. Relisting the home will reset the first data field so that when the home comes back on the market, its listed days on market resets to zero. This act keeps the days on market count low and is often strategically employed by real estate agents and homeowners to discourage low offers. This day count, however, is thus not always representative of the true amount of time a home has spent on the market. The current analysis examined the cumulative days a home spent on the market. This number may not be a perfect indicator and could still underestimate the true time a home spent on the market. This situation is rare but could occur if a home was able to acquire a different MLS number when relisted or if it was on the market for any period of time without an MLS number, as could be the case if the owner listed it for sale without the aid of a real estate agent. The

analysis in this study examined the cumulative days spent on market tied to one MLS number for the sampled homes.

When statistically analyzing the data regarding the days the sample homes spent on the market, an overwhelmingly robust difference was revealed. ENERGY STAR Homes (M = 98, SD = 117.88) spent statistically significantly fewer days on the market compared to code-built comp homes (M = 187, SD = 145.63), t (199) = -4.88, $p < .01$ (p = 0.0000). Results of the analyses, their distributions, and the distribution of sale price differences are shown in Figures 34 through 37. A summary of group means, standard deviations, mean differences, and *t*-test results, including significance level and *p*-values, can be found in Table 9.

Table 9. *Days on Market Statistics Including Group Means, Standard Deviations, Group Mean Differences, and* t*-test results, Including Significance Level and* p*-values, by Analysis Type*

Days on Market Analysis Statistics					
Group	**Mean**	**Standard Deviation**	**Mean Difference**	***p*-value**	**Level of Significance (Alpha Level)**
Sale Price Analysis:					
ENERGY STAR Homes	98	117.88	89	0.000002	0.01
Code-Built Comp Homes	187	145.63			

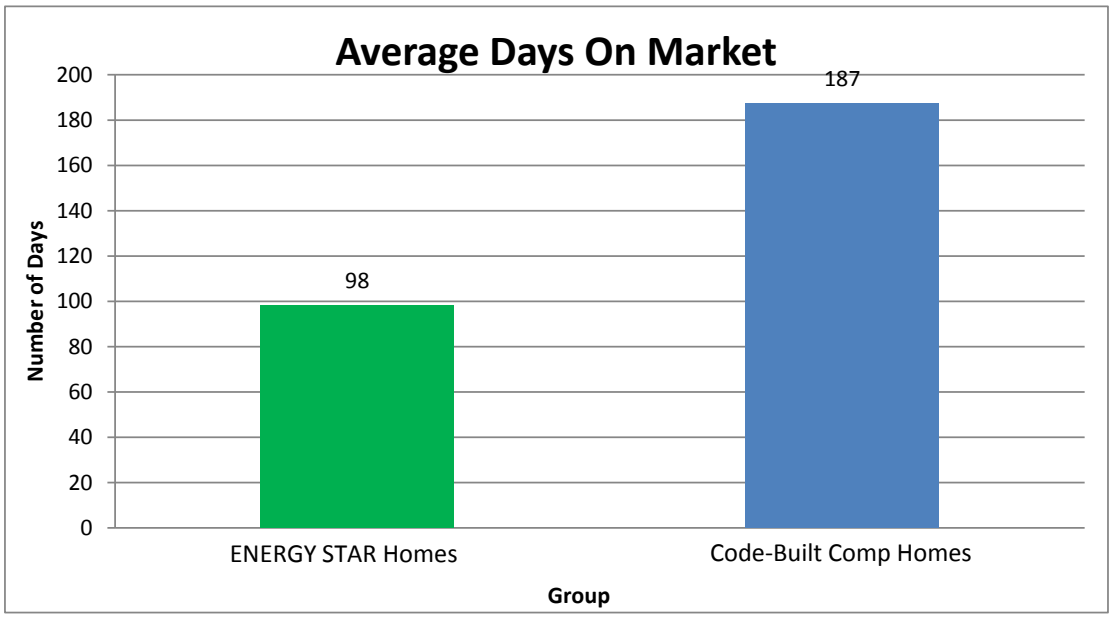

Figure 34. Group mean comparison for days on market data.

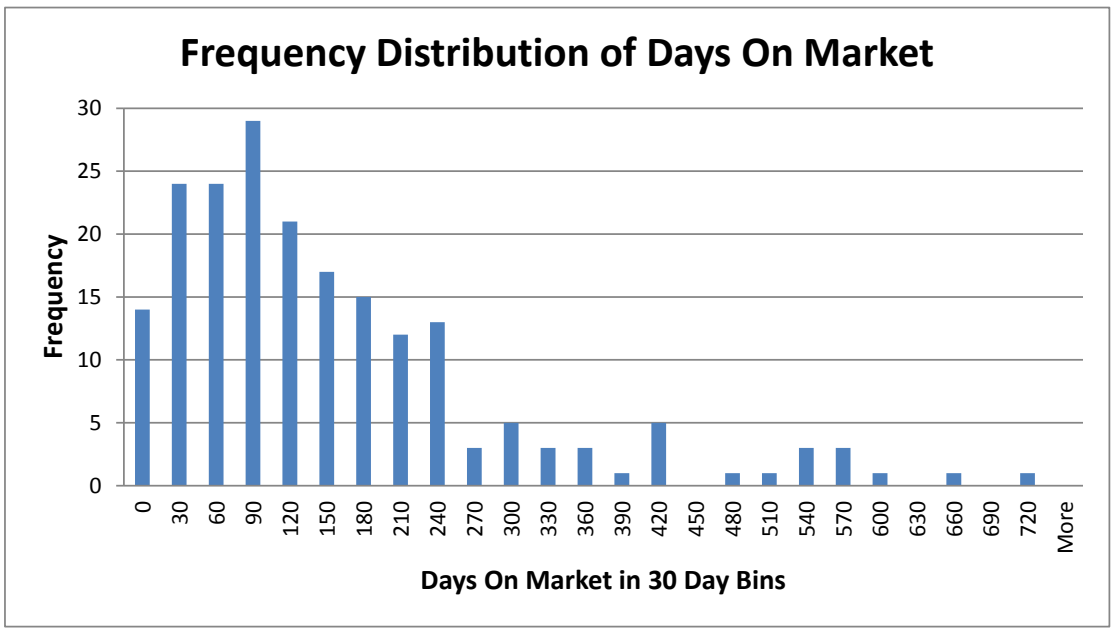

Figure 35. Frequency distribution of the days spent on the market by ENERGY STAR and code-built homes together, in bins of 30 days.

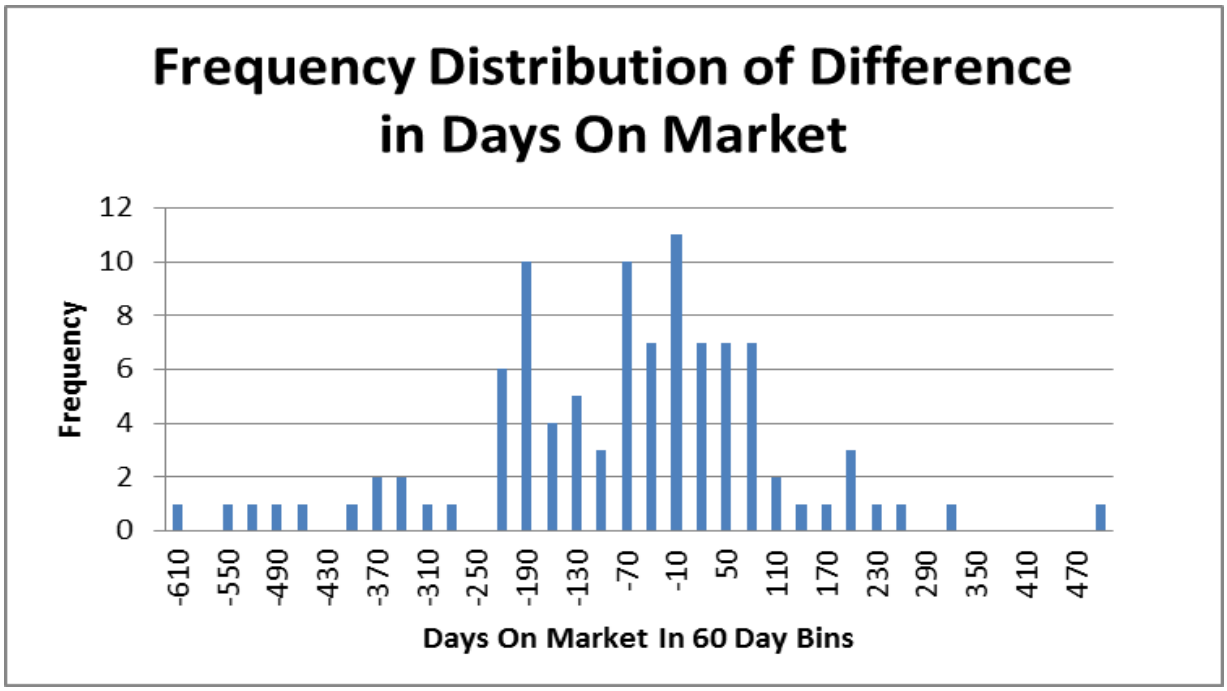

Figure 36. Frequency distribution of the differences in the days spent on the market between ENERGY STAR and code-built homes, in 60-day bins.

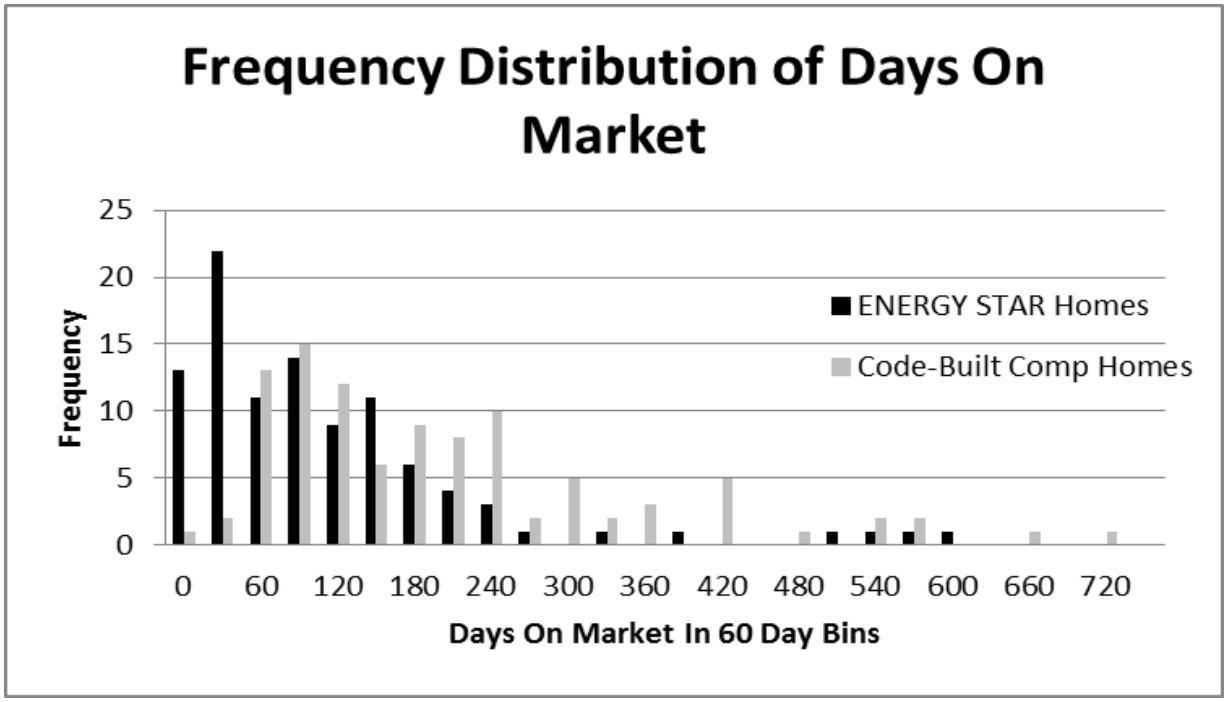

Figure 37. Frequency distribution of the days spent on the market by ENERGY STAR and code-built homes, separated in bins of 30 days. Note the ENERGY STAR distribution is shifted left and has a pronounced difference in the number of homes selling in under 30 days and has far fewer homes taking over 180 days to sell.

ENERGY STAR Homes again demonstrated a market advantage compared to the code-built comp homes when considering how long a home takes to sell. Results indicated that the sampled ENERGY STAR Homes sold significantly faster, far exceeding the $p < .01$ significance level, by an average of 89 days compared to their code-built counterparts. In similar real estate markets, real estate agents, builders, and homeowners can expect their ENERGY STAR listings to sell faster than a non-certified home. The large discrepancy uncovered in the analysis of days on market for the study sample was mathematically the strongest piece of evidence regarding ENERGY STAR Homes' market advantage. The days on market data suggest that even if other demonstrated market advantages, including sale price and price per square foot, were ignored, ENERGY STAR Homes could be sold fast enough to recover financial investments by simply saving on the carrying costs of holding a home while a buyer is found.

CHAPTER 5: CONCLUSIONS

ENERGY STAR Homes exhibited a market advantage in seven of the eight analyses undertaken in both Part I and Part II of the study. In Part I of the investigation, ENERGY STAR Homes failed to demonstrate significant market advantages only for a small number of selected counties within the population of homes examined. When examining the general trend of market performance at both the population level for the entire Triangle MLS region and for the five-county sub-region, ENERGY STAR Homes demonstrated clear market advantages, outperforming code-built homes in all categories. Part II of this study provided even stronger evidence of ENERGY STAR Homes' market advantage because it equated homes on as many dimensions as possible given real-world data constraints and thus minimized the possibility of confounding variables impacting results. Additionally, findings from Part II were made even more robust due to the random sampling procedure used. This two-part investigation, therefore, yielded strong evidence that ENERGY STAR qualification alone leads to market performance superiority.

The ENERGY STAR Homes sampled for Part II of the study significantly outperformed comparable homes in three of the four analyses carried out. Evidence of market advantages surfaced even when differences between groups were not minimized. For example, this advantage was found even when analyzing data where financial adjustments made by the third-party appraisal company to control for differences between properties were not considered. However, when the differences between ENERGY STAR Homes and their

code-built counterparts (where applicable) were minimized through the use of financial adjustments, the strongest evidence signifying ENERGY STAR Homes' market advantage was demonstrated. When differences were minimized through use of standard industry practice adjustments, ENERGY STAR Homes sold for an average sale price premium of $5,566 per home and $2.99 more per square foot compared to code-built comp homes. Additionally, ENERGY STAR Homes sold an average of 89 days faster than code-built comp homes. These results were found to be highly statistically significant. ENERGY STAR Homes also sold for a 0.48% greater proportion of their list price on average compared to code-built comp homes, although *p*-values for these analyses did not reach statistical significance. Still, these findings indicate that ENERGY STAR Homes do have strong, multidimensional market advantages when compared to similar code-built homes.

Implications for Home Buyers

At first glance, these results may seem problematic for the average home buyer. That is, this investigation indicates that ENERGY STAR Homes carry a higher up-front cost compared to a standard code-built home. Given the current economy, an average home buyer may feel uneasy or may be unwilling to make the additional investment to buy a new home that has achieved ENERGY STAR qualification. However, the up-front cost savings gained by choosing a non-certified home is quickly negated over the course of an average 30-year (or shorter period) mortgage. First, remember that in Part I of this study ENERGY STAR Homes were not found to be listing for higher prices compared with standard homes. Although it was found that ENERGY STAR Homes sold for more money, real estate agents and builders were not initially asking for more despite these homes' encompassing many additional and beneficial features that are built into the ENERGY STAR qualification

process. These features include a third-party verification system to assure buyers they are getting what they are paying for: a more comfortable home due to better insulation, air sealing, better windows, and more efficient appliances and lighting, to name a few. Owning a home that incorporates these features means it should be more durable and last longer than a standard code-built home. It could be that some consumers recognize these additional features found in ENERGY STAR Homes and are willing to pay more for them. It could also be that non-certified homes must be discounted further in order to compete in the market. However, this discount will actually end up costing the homeowners more over the course of their mortgage compared to the additional up-front investment on a similar ENERGY STAR qualified home.

ENERGY STAR Homes earn the homeowner monthly savings on utility bills of around 15% to 30% or more (Jones & Vyas, 2008; *Qualified New Homes*, n.d.). For the average homeowner this translates into appreciable savings that can pay for the added costs of ENERGY STAR qualification, typically in approximately five years. If looked at in terms of a 30-year mortgage, using the common rule of thumb, for every $1,000 borrowed one can expect to have approximately $1 of additional monthly mortgage payments, so with the lower energy bills ENERGY STAR Homes can actually produce a positive cash flow for homeowners. This net gain is achieved because the monthly savings on utilities will exceed the additional monthly mortgage cost associated with ENERGY STAR qualification. Additionally, while not widely available, some lending institutions provide mortgage incentives for ENERGY STAR homeowners.

The results of the investigation also indicate two other important factors for the prospective home buyer to be aware of when choosing between an ENERGY STAR Home

and a non-certified home. The first recognizes that there is a growing body of research pointing towards the added value of energy-efficient features in homes. This research indicates that homeowners will be able to recoup investments in energy efficiency through higher achieved sales prices, faster sale/resale, or reduced operating costs over the first few years of living in their home. Many studies (Halvorsen & Pollakowski, 1981; Johnson & Kaserman, 1983; Longstreth, 1986; Laquatra, 1986; Dinan & Miranowski, 1989; Horowitz & Haeri, 1990; Nevin & Watson, 1998) have found that more efficient homes sell for higher sale prices. Moreover, the appraisal industry may be convinced by this growing body of research to place added value on homes with energy-efficient features, thus better securing a homeowner's investment. The second factor takes into consideration the results of the days on market analysis. In Part II of this study, sampled ENERGY STAR Homes were found to sell 89 days faster than non-certified homes while Part I of this study indicated a 42-day advantage. If this trend is generalized to any home sale, ENERGY STAR homeowners can expect, in a similar market, that their home will sell faster than if it were not ENERGY STAR qualified. This faster sale could carry with it a number of benefits including being able to qualify for financing on a new home faster, eliminating the need to have multiple homes and costs associated with owning two homes, facilitating relocation, and reducing the expenses involved with selling a home.

Implications for Home Builders and Real Estate Agents

The advantage encompassed in building and selling ENERGY STAR Homes is very straightforward for home builders and real estate agents. Findings indicate that ENERGY STAR Homes sell for more and sell faster than the code-built comp homes. In markets similar to the one analyzed for this investigation, home builders should have multiple

avenues for recouping additional investments required when building to ENERGY STAR qualification standards. Additionally, real estate agents have good reason to support ENERGY STAR Homes as they can expect these homes to sell faster and at a higher price point. The findings indicate that home builders should be able to sell their product for more than a similar non-certified offering by a competitor. Findings suggest that there is potential for higher profits for home builders and larger commissions for their real estate agents. In fact, because of the relatively low additional cost of building to ENERGY STAR qualification, gains in achieved sale prices may prove financially advantageous. ENERGY STAR Homes also sell significantly faster than non-certified homes, meaning reduced carrying costs for home builders and less time investment for real estate agents, freeing them to focus on other listings. As indicated by both parts of the study, ENERGY STAR Homes may sell fast enough that savings in carrying cost reductions alone could prove the investment in qualification profitable several times over. Moreover, the home builder/real estate agent team may take satisfaction in offering their clients a product that will provide them a more enjoyable living experience, is more environmentally responsible, is a higher quality product, and is one that will ultimately save them money. These less direct, consumer-related benefits could circle back to the home builder or real estate agent by decreasing warranty claims and increasing referrals and positive company image.

Implications for the Appraisal and Lending Industries

Lastly, the findings of this investigation have implications for appraisers and lenders. These industry professions often coordinate during the home buying process and hold a great deal of power in determining what home a prospective home buyer will be able to purchase. This relationship between appraisers and lenders is largely due to the mortgage approval

process, which requires a home to be appraised prior to approving the amount of the loan. The amount of the loan is often changed to reflect what the home has been valued at based on the appraisal. Lenders use a set of standardized criteria for determining if a potential mortgage recipient will be able to pay off the loan. Part of these criteria examine the home buyer's housing cost-to-income ratio, which utilizes a preset percentage designed to capture what a potential home buyer can afford to pay monthly. This preset percentage ignores that energy-efficient homeowners have reduced monthly home operational costs and are subsequently able to pay larger mortgage amounts. Moreover, if the benefits of energy-efficient home features are ignored in the appraisal report (Ball, 2011), the loan amount may not be enough to cover the additional cost of these features, putting more efficient homes outside the financial reach of some home buyers. Therefore, assuming the appraisal report has not assigned an appropriate value to energy efficient features, the larger up-front cost can reduce the chances of securing a loan despite the known financial benefits of energy-efficient certification.

Many studies (Halvorsen & Pollakowski, 1981; Johnson & Kaserman, 1983; Longstreth, 1986; Laquatra, 1986; Dinan & Miranowski, 1989; Horowitz & Haeri, 1990; Nevin & Watson, 1998) have already shown that homes incorporating energy efficiency features sell for more than less efficient homes. The results of this investigation support those previous findings, suggesting there is evidence that the energy efficiency tied to ENERGY STAR qualification can add to a home's market value. Furthermore, recent market analyses (Mathews, 2009; Griffin, 2009; Argeris, 2010; Mosrie, 2011) have demonstrated that homes with energy-efficient building certifications sell for more in today's market. The evidence produced in both Part I and Part II of this investigation reflects actual home sales data that is

independent of any particular home's appraised value. This means that the market already values energy efficiency, even if it is ignored during the appraisal process. This recurrent theme and growing body of research suggests that value tied to energy efficiency can no longer be ignored and must be considered during the appraisal process.

Valuing energy-efficient home features can alleviate many of the problems facing widespread implementation of building efficiency programs across the country. It would enable builders to be more assured that their additional investment would be recoverable at the time of sale, and it may allow them to secure construction loans that cover this additional investment. Proper valuation will help home buyers in obtaining a mortgage that covers the added up-front expenses of energy-efficient construction, while giving lenders assurance that the collateral against the loan is valued properly.

Summary

This investigation examined the market performance of ENERGY STAR Homes compared to non-ENERGY STAR qualified homes utilizing two distinct methodologies. The evidence produced by this investigation suggests that ENERGY STAR Homes have a competitive market advantage compared to similar code-built homes. It was found that these homes sold for more and sold in less time compared with similar code-built homes. This multidimensional advantage is substantial enough to suggest to home builders and home buyers that the additional investment in ENERGY STAR qualification is recoverable upon the home sale and may even prove profitable. The findings of this study also contain implications for the lending and appraising industries, providing further evidence that there is value tied to energy-efficient home features as expressed through regular market transactions.

This evidence supports a transition to assigning value to energy-efficient features as a standard appraisal practice. While the findings of Part II of the study have a high degree of statistical significance in the greater Raleigh, North Carolina housing market, replication of the study should be conducted in other markets to further validate the robustness of the current investigation's findings. Understanding real market impacts and valuing energy efficiency properly can facilitate widespread implementation of energy-efficient building certification programs on a national scale and help to alleviate the country's growing energy burden. Implications of these results should also be capitalized on by many of the housing market's key stakeholders, including home buyers, home builders, real estate agents, appraisers, and lenders.

Suggestions for Future Research

The current investigation provides evidence of the market advantages of building an ENERGY STAR qualified new home in central North Carolina. While this research has yielded strong evidence and taken acceptable precautions to maximize its generalizability, it has also uncovered information deficits that could serve as areas for future research. It would be beneficial to replicate this study in other regions of North Carolina where the local MLS contains categories for delineating if homes hold particular green building certifications. For example, the greater Charlotte region and the Asheville area of North Carolina now have sufficient MLS data to begin this process. Concurrently, it would be similarly beneficial to conduct this same research in many other applicable states. A variation of this research could take a meta-analytic approach and randomly sample homes from across the nation such that the ENERGY STAR Home sample was populated with homes from multiple states

representative of the entire United States. If results similar to those found in the present investigation were generated, it would be further evidence of the robustness of the findings contained in this report and provide further evidence demonstrating ENERGY STAR Homes' market advantage.

Additional research is also needed to better comprehend what consumers understand about the benefits of ENERGY STAR qualification. This research would target consumer understanding of the relative costs versus the additional financial and qualitative benefits of ENERGY STAR qualification. It may also focus on exactly what consumers are willing to pay (or will find reasonable to pay) for an ENERGY STAR qualified home compared to the sale price of a code-built home. Data from this line of research may help to explain why there was no significant market advantage found when examining the proportion of the list price an ENERGY STAR Home sold for compared to the code-built comp homes.

Similarly, research should be conducted to better understand how home builders price their homes for the market. Having a better understanding of this process may also help to explain some of the findings generated in this study. For instance, it was found that the ENERGY STAR Homes sampled in this study were not priced statistically significantly higher than the code-built homes. Was this to remain competitive in the regional marketplace by lowering the potential profit margin on the home? Do home builders believe that energy efficiency will be an insignificant motivator for home buyers? Conducting this line of research would also lend itself to gathering data of another kind that may provide additional incentive for builders to build to ENERGY STAR qualification. Because it will be necessary to interview home builders on their methodology for determining list price, additional information related to warranty claims and callbacks for homes with and without certification

should be gathered. If it is found that ENERGY STAR Homes have significantly fewer callbacks and warranty claims, additional incentives to building to ENERGY STAR qualification standards can be provided to the home building industry. Having reduced callbacks and warranty claims means less time investment and decreased profit loss post sales for home builders.

Research should be conducted that targets any additional reasons builders are hesitant to undertake qualifying their new homes with ENERGY STAR. Based on the extensive industry contacts that informed the efforts of the NCEEA it was assumed that builders' primary reasons for avoiding ENERGY STAR were financial in nature and were also a result of an education deficit regarding ENERGY STAR building requirements and the qualification process. More focused research on this topic could lead to the development of targeted skills training workshops for builders that could increase the prevalence of new ENERGY STAR Homes being built by equipping home builders with the information they need. As part of these workshops home builders could also be educated on the various other advantages of building to ENERGY STAR qualification uncovered by the present investigation to reduce unwillingness to participate related to financial concerns.

Lastly, the research methodology conducted in this report should be replicated periodically over the next several years to ensure that the economic recession experienced in 2010 or that increasing energy costs have not held a confounding amount of influence on the results. It could be that in tough economic times people seek the best possible value for their housing investment, which ENERGY STAR qualification caters towards. However, similar to trends in the past, when the recession lifts home buyers may revert to a mentality less concerned with value and efficiency, which could lessen the market advantage of ENERGY

STAR Homes found herein. Research indicating similar findings across a multitude of locations and economic contexts would be paramount in demonstrating the robust nature of the market advantage of ENERGY STAR Homes.

References

2009 ENERGY STAR qualified new homes market indices for states. (2009). [Graphic depicting state market indices of ENERGY STAR implementation and national average]. *Features & Benefits of ENERGY STAR Qualified New Homes.* Retrieved from http://www.energystar.gov/index.cfm?fuseaction=qhmi.showHomesMarket Index

About the Alliance. (2011). Retrieved from http://ncenergystar.org/about/about-alliance

Argeris, K. (2010). *High performance homes sell better in the Triangle*. Retrieved from http://www.raleighquickappraisals.com/High+Performance+Homes+Sell+Better+in +the+Triangle

Ball, L. F. (2011). *Assessment of the green building needs of North Carolina real estate appraisers*. (Unpublished doctoral dissertation). Prescott College, Prescott, AZ.

Banerjee, A. & Solomon, B. D. (2003). Eco-labeling for energy efficiency and sustainability: a meta-evaluation of US programs. *Energy Policy, 21*(2003), 109-123.

Corgel, J. B., Goebel, P. R., & Wade, C. E. (1982). Measuring energy efficiency for the selection and adjustment of comparable sales. *The Appraisal Journal,* (1), 71-78.

Dinan, T. M., & Miranowski, J. A. (1989). Estimating the implicit price of energy efficiency improvements in the residential housing market: A hedonic approach. *Journal of Urban Economics, 25*(1), 52-67.

Dixon, G., Abdel-Salam, T., & Kauffmann, P. (2010). Evaluation of the effectiveness of an energy efficiency program for new home construction in eastern North Carolina. *Energy, 35*(2010), 1491-1496. doi: 10.1016/j.energy.2009.12.006

Dixon, R. K., McGowan, E., Onysko, G., & Sheer, R. M. (2010). US energy conservation and efficiency policies: Challenges and opportunities. *Energy Policy, 38*(2010), 6398-6408. doi: http://0-dx.doi.org.wncln.wncln.org/10.1016/j.enpol.2010.01.038

Features & benefits of ENERGY STAR qualified new homes. Retrieved (n.d.) from http://www.energystar.gov/index.cfm?c=new_homes.nh_features

Griffin, A. (2009). *Certified home performance: assessing the market impact of third party certification on residential properties* [White paper]. http://pacenow.org/documents/seattle_green_real_estate_premium.pdf

Halvorsen, R. & Pollakowski, H. O. (1981). The effects of fuel prices on house prices. *Urban Studies, 18*(2), 205-211.

Horowitz, M. J. & Haeri, H. (1990). Economic efficiency v. energy efficiency: Do model conservation standards make good sense? *Energy Economics*, *12*(4), 122-131.

Johnson, R. C. & Kaserman, D. L. (1983). Housing market capitalization of energy saving durable good investments. *Economic Inquiry,* (7), 374-386.

Jones, P. & Vyas, U. (2008). Energy performance in residential green developments: A Florida case study. *Real Estate Issues, 33*(11), 65-71.

Laquatra, J. (1986). Housing market capitalization of thermal integrity. *Energy Economics* (7), 134-138.

Longstreth, M. (1986). Impact of consumers' personal characteristics on hedonic prices of energy-conserving durable good investments. *Energy*, *11*(9), 893-905.

Mathews, C. (2009). *Certified green homes sales in Atlanta, GA 2009*. Retrieved from http://greentothescene.files.wordpress.com/2010/03/atlanta-2009-green-sales-nar.pdf

Mitchell, W., Bloise, V., & Matthews, K. (2010). *2010 appraisal industry research.* Raleigh, NC: Advanced Energy.

Mosrie, D. (2011). Just the facts: Asheville's green housing market. *Western North Carolina Green Building Directory 2011*, 82-83. Retrieved from http://www.wncgreenbuilding.com/articles/full/just_the_facts

National Association of Home Builders Research Center, Inc. (2005). *ZEH preliminary market analysis: General investigation of the residential appraisal industry.* Upper Marlboro, MD: National Renewable Energy Lab.

Nevin, R. (2010). Energy-efficient housing stimulus that pays for itself. *Energy*, *38*(2010), 4-11. doi: http://0-dx.doi.org.wncln.wncln.org/10.1016/j.enpol.2009.09.013

Nevin, R. & Watson, G. (1998). Evidence of rational market valuations for home energy efficiency. *The Appraisal Journal*, (10), 401-409.

Qualified new homes: ENERGY STAR. Retrieved (n.d.) from http://www.energystar.gov/ index.cfm?c= new_ homes.hm_index

Rasch, D., & Guiard, V. (2004). The robustness of parametric statistical methods. *Psychology Science*, *46*(2), 175-208.

Triangle MLS adds green fields. (2009). Retrieved November 30, 2011, from http://trianglegreenhomes.wordpress.com/2009/03/16/triangle-mls-adds-green-fields/

U.S. Energy Information Administration. (2009). [Pie graph depicting the energy consumed by sectors of the economy for 2009]. *Annual Energy Review 2009*. Retrieved from http://www.eia.doe.gov/energyexplained/index.cfm?page=us_energy_use

U.S. Energy Information Administration. (2005). [Pie graph depicting how energy is used in homes for 2005]. *Residential Energy Consumption Survey 2005*. Retrieved from http://www.eia.doe.gov/energyexplained/index.cfm?page=us_energy_homes

Use of electricity. (2010, November 2). Retrieved from http://www.eia.doe.gov/energy explained/index.cfm?page=electricity_use

Williams, M. R. & Ventolo, W. L. (1994). *How to use the Uniform Residential Appraisal Report* (2nd ed.). Chicago, IL: Dearborn Financial.

Vita

William Robert Pfleger, Jr. was born March 19th, 1982 in Brighton, MI to William and Kathy Pfleger. He earned a B.S. in Psychology in May of 2004 and a M.A. in Experimental Psychology in August of 2006 from Appalachian State University. After working in the construction and engineering fields for several years as an entrepreneur, designer, project scheduler, and manager he returned to Appalachian State University to begin Master's work in Building Science and Appropriate Technology in January of 2011.

He has had a lifelong passion for the environment and building design reinforced through his work experience. After completing several remodeling and construction projects through his own startup company he wanted to learn how to better design projects to encompass more sustainable practices.

Immediately after acceptance to Appalachian State University's M.S. program through the Department of Technology and Environmental Design, he started work with the NCEEA, an organization that shared his passion for building green. The NCEEA was a major sponsor of his thesis work and this research, along with numerous other efforts, subsequently contributed to the NCEEA's multiple 2011 EPA ENERGY STAR Awards.

His research on ENERGY STAR Homes earned him an Appalachian State University Student Research Day Award in 2012. Also in 2012, he was asked to represent Appalachian State University at the state capital in Raleigh, NC on Graduate Research Day, where he spoke with members of the North Carolina State Legislature. He plans to continue research and design work in sustainable and net zero building design and construction for the foreseeable future.