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## Market Impacts of ENERGY STAR<sup>®</sup> Qualification for New Homes



### ENERGY STAR HOMES

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## Abstract

Buildings represent 41% of the annual energy consumption, more than either industry or transportation, in the United States (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 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.), saving homeowners hundreds of dollars annually in utility costs.

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. Additionally, the appraisal industry has had difficulty establishing a standard valuation method for these energy efficiency upgrades, in large part because market data has not been available to compare ENERGY STAR Homes with their comparable code-built counterparts.

The present study provides statistically significant analysis that ENERGY STAR qualified new homes sell faster (i.e., fewer days on the market) and for higher prices (i.e., sell for higher prices, or sell for a greater percentage of the listing price, or have a higher price per square foot) than comparable nonqualified homes, providing valuable evidence that there is a market advantage for ENERGY STAR qualified homes.

## 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 energy management practices. To accomplish this initiative, 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 reducing energy use (Dixon, McGowan, Onysko, & Sheer, 2010).

In the US, residential and commercial buildings represent roughly 41% of the annual energy consumption including electricity use and the use of other energy sources like natural gas and fuel oil. This figure constitutes more energy usage than any other sector, including transportation and industry, 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.

## 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 and market performance.

The NCEEA is 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 throughout the state. The four founding partners of the NCEEA include Appalachian State University, the North Carolina Solar Center, Advanced Energy, and Southern Energy Management. This Alliance 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 allied organizations.

The NCEEA aims to benefit the housing industry by overcoming market barriers by educating home buyers, training home builders and real estate agents, strengthening the Home Energy Raters (HERS) network, and educating appraisers and lenders on the benefits and value of energy efficiency. By engaging each of these groups collectively, the NCEEA intends to stimulate and support the market for energy-efficient homes in the state of North Carolina and pave the way for the adoption of energy-efficient building practices in other states. The Alliance offers regular workshops for building professionals, continuing education trainings, networking opportunities, as well as printed publications, online resources, and consumer outreach initiatives across the state. (*About the Alliance*, 2011).

## 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. 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 building program and housing qualification. 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 included 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 (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.

### **Valuation of Energy-efficient Homes & Home Features**

The process of changing appraisal practices commenced decades ago. An investigation conducted by Corgel, Goebel, and Wade (1982) argued that appraisers should gather information on a home's efficiency, taking infrared photos of it and examining utility bills, for example, and objectively interpret its added value based on market comparisons. They found that of a sample of 100 single family homes in Lubbock, Texas, homes that were designated as relatively energy efficient through these techniques sold for an average premium of \$3,416. Additionally, 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 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 buyers of high performance homes 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. Unfortunately, standard lending practices ignore this benefit of purchasing an energy-efficient home.

Historically, there is reason to believe that homes built to a higher efficiency standard are worth more. In the 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 as 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 improvements in efficiency.

A study conducted by Halvorsen and Pollakowski (1981) 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 et al. (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 rational trade-off meant that 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.

Johnson and Kaserman (1983) found that for every dollar reduction in a home's annual energy consumption, its value increased by \$20.73. Dinan and Miranowski (1989) found that a home's

value increased slightly less, an average of \$11.63 for every one dollar reduction in home fuel expenditures. In 1990, Horowitz and Haeri replicated these results, finding that the value of every a one dollar reduction in annual electricity bills increased the home's value \$12.52. Nearly ten years later these findings were upheld again by Nevin and Watson in 1998, who found that home values increased about twenty dollars for every one dollar reduction in annual utility bills. These findings are particularly striking since ENERGY STAR Homes are known to reduce energy costs around 15-30%, meaning there should be an appreciable increase in those homes' market values.

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. Historically, studies have demonstrated that simply improving a home's insulation and thermal integrity alone can add to its value. Laquatra (1986) 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. Additionally, adding insulation to a home's walls and ceiling increased its value. Specifically, she found that a one inch increase in wall insulation increased the value by \$1.90 per square foot of conditioned space. Concurrently, she found a one inch increase in ceiling insulation increased the value by \$3.37 per square foot of conditioned space (Longstreth, 1986; see also Nevin & Watson, 1998).

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 certified homes in Portland, Oregon sold for an average of 4.2% more and 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' price per square foot declined. A market analysis conducted by Atlanta, Georgia-based eco-broker Carson 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 less 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. The current investigation includes similar results showing a significant financial return in investing in the ENERGY STAR program.

## 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 and other certification programs generally require added upfront 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 account for energy efficiency is vital, the process has been slow-moving despite strong evidence to support this initiative.

While it is true that some parallels exist between today's tough economic climate and the economic conditions present when many of the mentioned past studies were conducted, new evidence gathered from recent homes sales is needed. Additionally, current market analyses, discussed previously, do not consider the impact of ENERGY STAR qualified homes alone. Instead, these analyses group all homes with any type of building certification together and compare them against code-built homes. This procedure represents an unfair analysis because many building certification programs require a large 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 represents a relatively small 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 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 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 MLS. The Triangle MLS has been an industry leader in providing information on energy-efficient certifications for homes since April of 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.

## Hypothesis and Research Questions

The present investigation hypothesizes that ENERGY STAR qualification gives a home a competitive market advantage. Competitive market advantage will be 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 reliably brought 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?

## Limitations of the Study

The present investigation is designed to provide evidence supporting the hypothesis that ENERGY STAR Homes have a competitive market advantage compared to similar code-built homes. Given the nature of the study and its use of data representing actual home sales a number of limitations must be acknowledged.

The generalizability or external validity of the results of this study may be limited by the specific region from where 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 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. It should also be mentioned, however, that a small geographic sampling area is a limitation encountered by most investigations of this kind.

The data used 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 could contribute to findings surrounding the questions under investigation herein (such as some custom homes or presales). Unfortunately, this data is not captured by the MLS and as a result is not represented in the study. Additionally, MLS records are most commonly created through data entered directly by real estate agents or 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 conceivable that some persons responsible for inputting the MLS data are unaware of the field's existence. Concurrently, these persons may be unaware that a particular home has any green certification due to a lapse of communication by the home builder or other involved party.

The study may also have 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 this instance, the ability to have similar homes to compare took precedence over when the homes sold. Thus, the time of sale may have varied 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. 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, an overwhelming majority of comparable homes in the study, over 75%, sold within approximately six months or less of their subject property. Compounding this problem, each ENERGY STAR Home in this study is compared to three code-built homes, making the availability of acceptable comparison properties that much more difficult. Despite this difficulty, having three comparison properties captures a much more accurate representation of properties that approximate the subject property. To best combat this problem the current investigation should be replicated incrementally 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.

Finally, the results produced by the current investigation may be impacted by inequities between ENERGY STAR and code-built homes that are not accurately accounted for or are simply ignored during the appraisal process. Measures were taken to address this potential limitation. However, standard appraisal industry practice, which historically has ignored the value of energy-efficient home features, is the most common and best established and regulated method for accounting for differences between properties. The current investigation utilized standard appraisal industry practices combined with a number of researcher specified requirements aimed at making the processes more accurate. These additional appraisal guidelines will be discussed in the section titled “Appraisal property data set.”



## Significance of the Study

The results of the present investigation provide home construction industry professionals with powerful evidence on the market advantages of building to ENERGY STAR qualification standards. Furthermore, the results offer much needed evidence for the lending and appraising industries with regard to market impact that up until now has given little consideration to the energy efficiency of buildings. Additionally, no study has been conducted trying to link ENERGY STAR qualification alone with potential added market value. Previous studies and market summaries, like Griffin's (2009) study, examined homes that had any type of green certification or that had multiple certifications. Many other green certifications (e.g., LEED, Passivhaus, etc.) can add substantial 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. ENERGY STAR qualification alone, representing a relatively modest investment, is a program better suited for widespread implementation. Demonstrating its financial viability to lenders, appraisers, home builders, and home buyers alike represents a critical step in reducing home energy use.

## Research Methods

The present investigation aims to determine if there is a statistically significant market advantage for new homes that have obtained ENERGY STAR qualification compared to similar code-built homes. A market advantage for the purposes of this investigation is 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. Data examining the 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 important indicator to home builders of consumer willingness to pay for energy efficiency. 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 real estate agents.

## Sample

The investigation uses two sets of data for statistical analysis. The first data set consists of a proportional stratified random sample of 100 ENERGY STAR qualified new 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 that contribute to home pricing and 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 consists of 300 homes that have been appraised to be as similar to the ENERGY STAR Homes as possible given real world constraints and construction differences. Each ENERGY STAR Home has three comparable properties in the non-ENERGY STAR Homes group. These comparable properties have been determined to be as similar to the ENERGY STAR Home as possible as designated by

a third-party appraisal company. Furthermore, the appraisal company made financial adjustments to applicable comparison properties based on the features found in each individual home and according to standard appraisal industry practices. These adjustments ensure 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 tied directly to the ENERGY STAR qualification. For example, it is not uncommon to compare an ENERGY STAR Home containing three bedrooms and two full baths to a property that includes three bedrooms and three bathrooms. Logically, this means a difference in the number of bathrooms could be driving a price difference between the two homes. The appraisal company determines the value of the extra bathroom in the comparison property and would make a corresponding adjustment in its price to account for this difference. These adjustments provide a quasi-control for home pricing since not every home is exactly the same in terms of location and features/amenities.

## Data Collection

Both sets of data used were generated from the Triangle Multiple Listing Service (MLS) from the years 2009 and 2010. The Triangle MLS contains data on the majority of new homes sold in and around the Raleigh/Durham 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. Data for both groups comprising the sample contain only 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. In short, this selection method prevented a disproportionately high numbers 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 disproportionately high number of homes coming from any one county.

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. 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 misrepresented. Inaccuracies like this and other similar complications that could arise from simple random selection might artificially drive the price of ENERGY STAR Homes.

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 appraisal company. 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 their licensed ability to conduct the appraisal process. A licensed appraiser is subject to review, continuing education requirements, and must uphold industry standard practices.

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.” 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 (Advanced Energy, 2010). These comparable properties are generally close in geographic location to the subject property and have sold within a similar timeframe, 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 that of 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 similarities between ENERGY STAR Homes and their comparables is essential for determining if the ENERGY STAR label and its related efficiency increases have a significant impact on a home's marketability. The ten selection guidelines that were used along with standard appraisal industry practices are discussed in terms of the subject property (the ENERGY STAR Home) and its comparison properties (comps), and include 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 exist between the ENERGY STAR Homes and 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 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 when examining nonparametric data (Rasch & Guiard. 2004).



## 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 Homes' sale prices and compares them to the code-built comp homes' sale prices. The sale price data was generated from the data field on the MLS datasheets labeled "sale price" and is 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 are 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 1-7. A summary of group means, standard deviations, mean differences, and t-test results including significance level and p-values can be found in Table 1.

**Table 1.** Sale price analyses statistics including group means, standard deviations, group mean differences, and t-test results including significance level and p-values by analysis type.

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

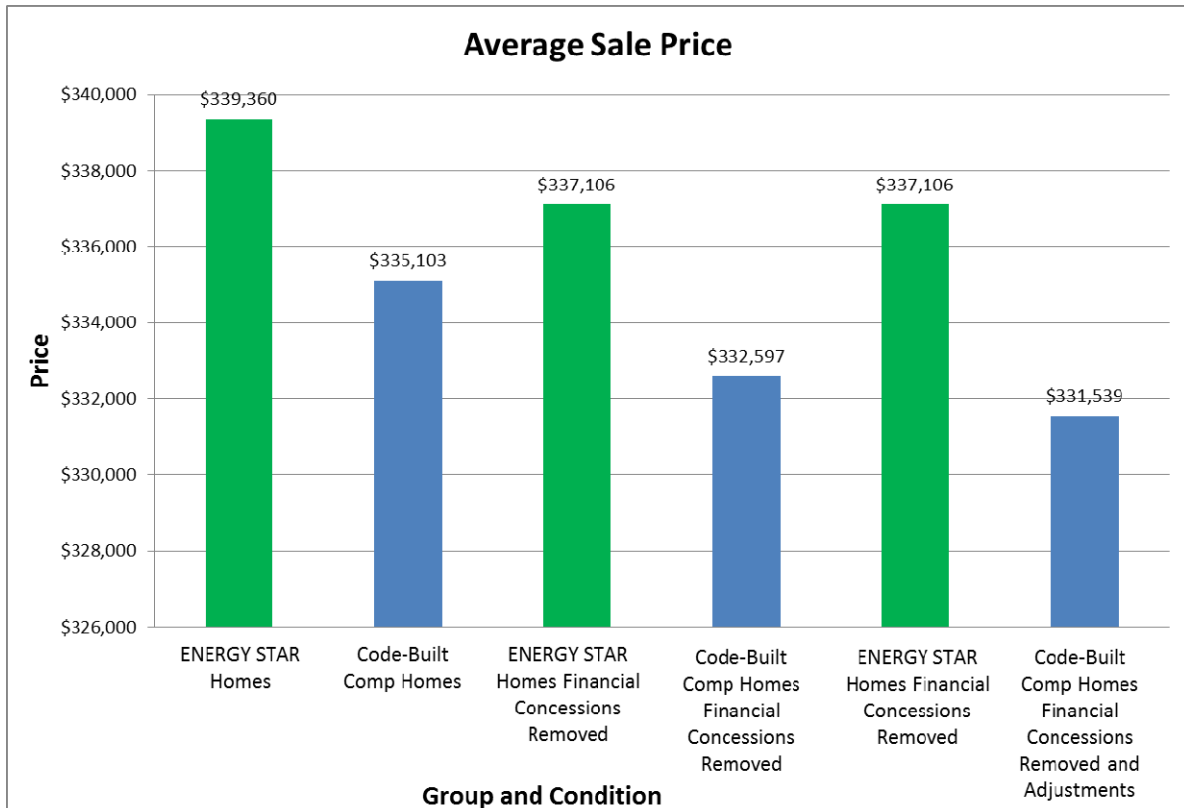


Figure 1. Group mean comparison for sale price data for all three analytic approaches.

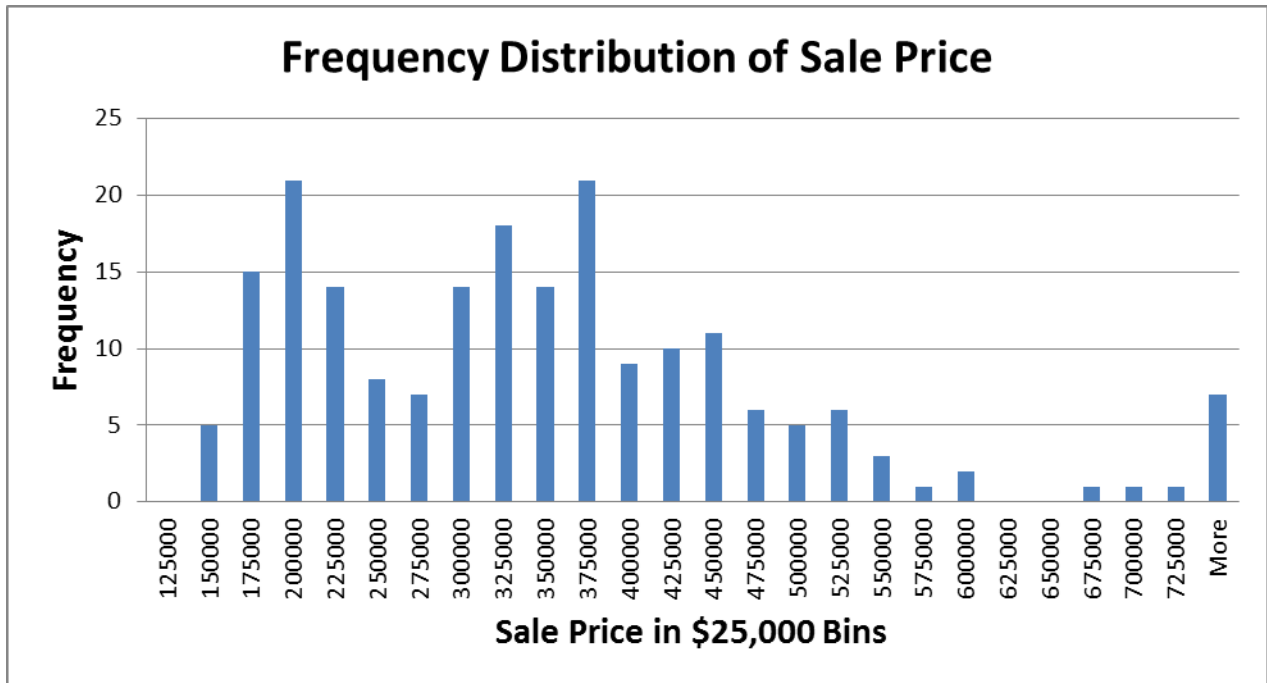


Figure 2. Frequency distribution of sale prices of ENERGY STAR and code-built homes combined, in \$25,000 increments.

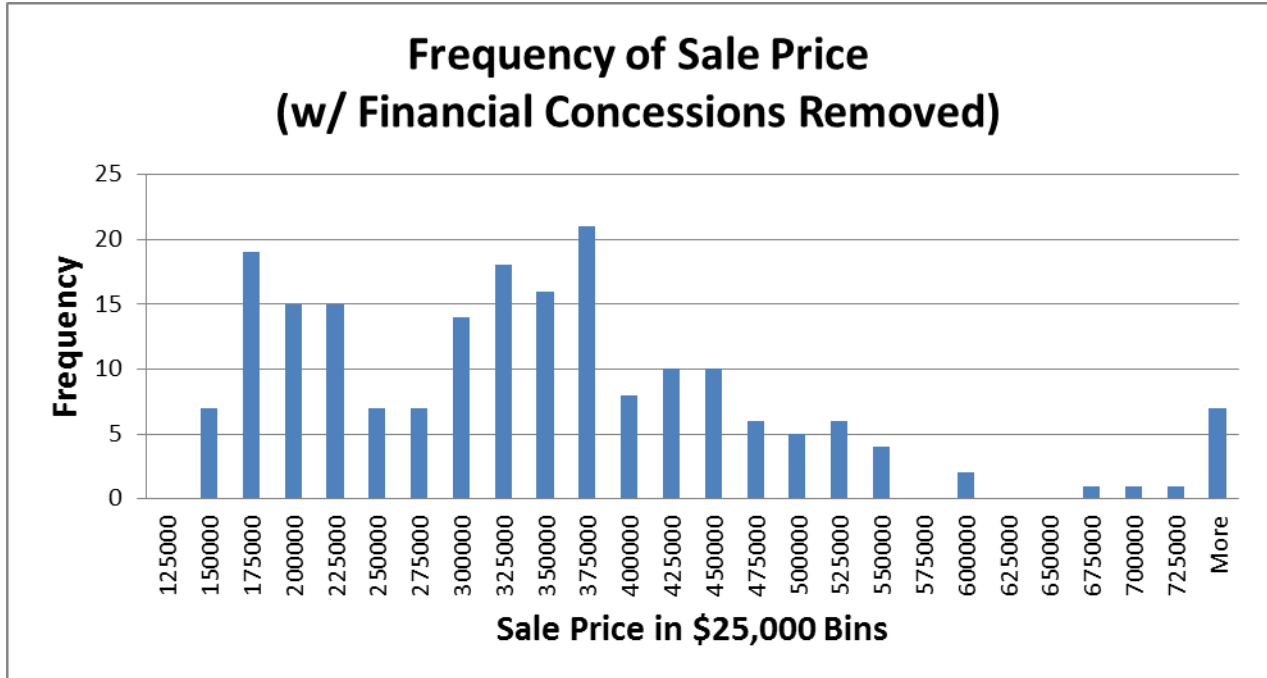


Figure 3. Frequency distribution of sale prices after financial concessions are removed of ENERGY STAR and code-built homes combined, in \$25,000 increments.

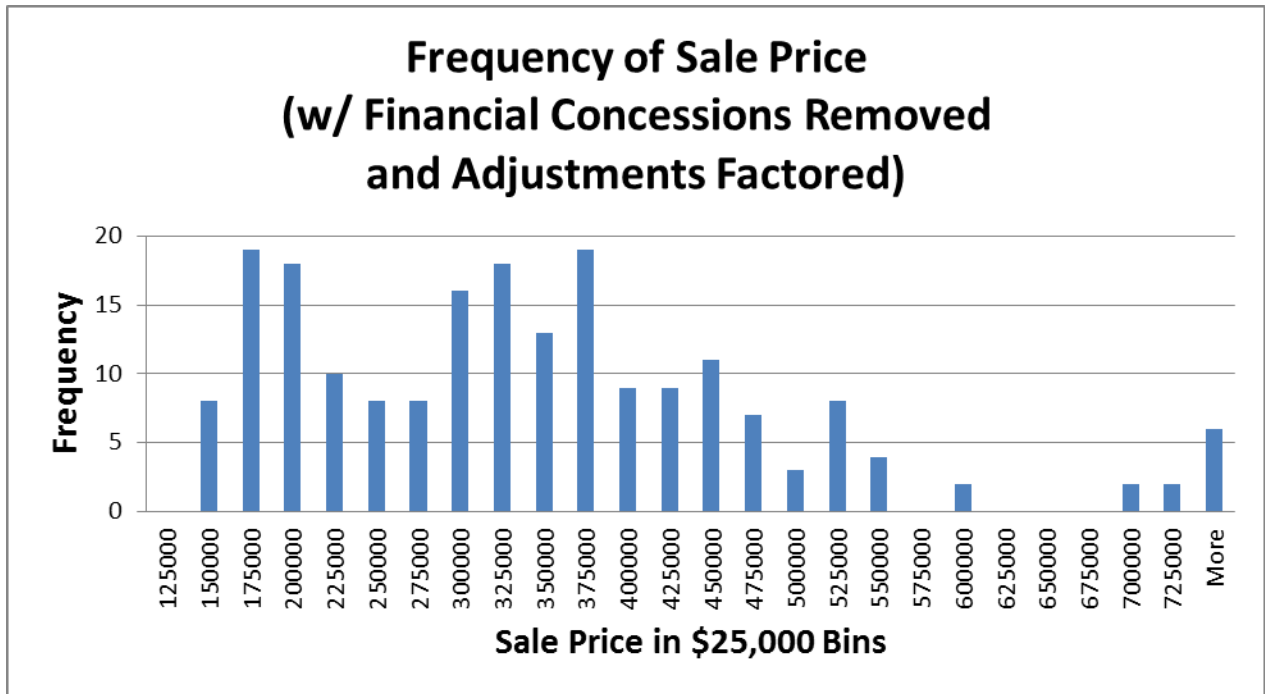


Figure 4. Frequency distribution of sale prices after financial concessions are removed and financial adjustments are accounted for of ENERGY STAR and code-built homes combined, in \$25,000 increments.

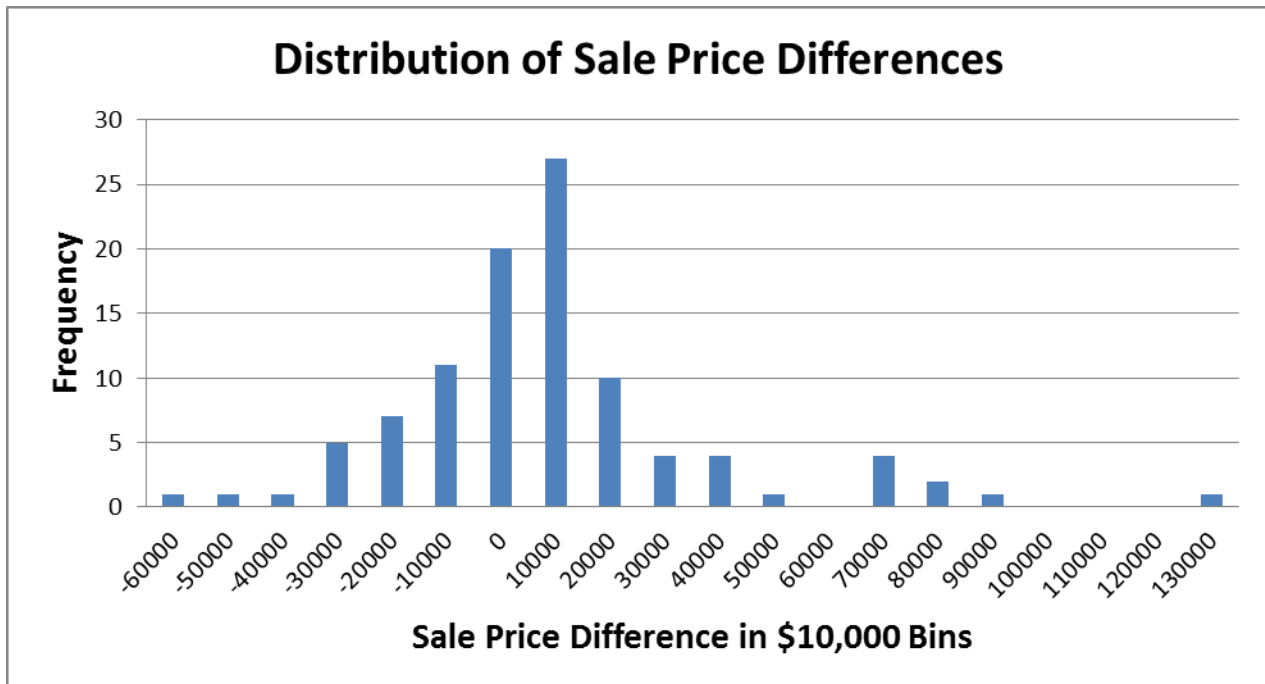


Figure 5. Frequency distribution of sale prices differences between ENERGY STAR Homes and code-built comp homes in \$10,000 increments.

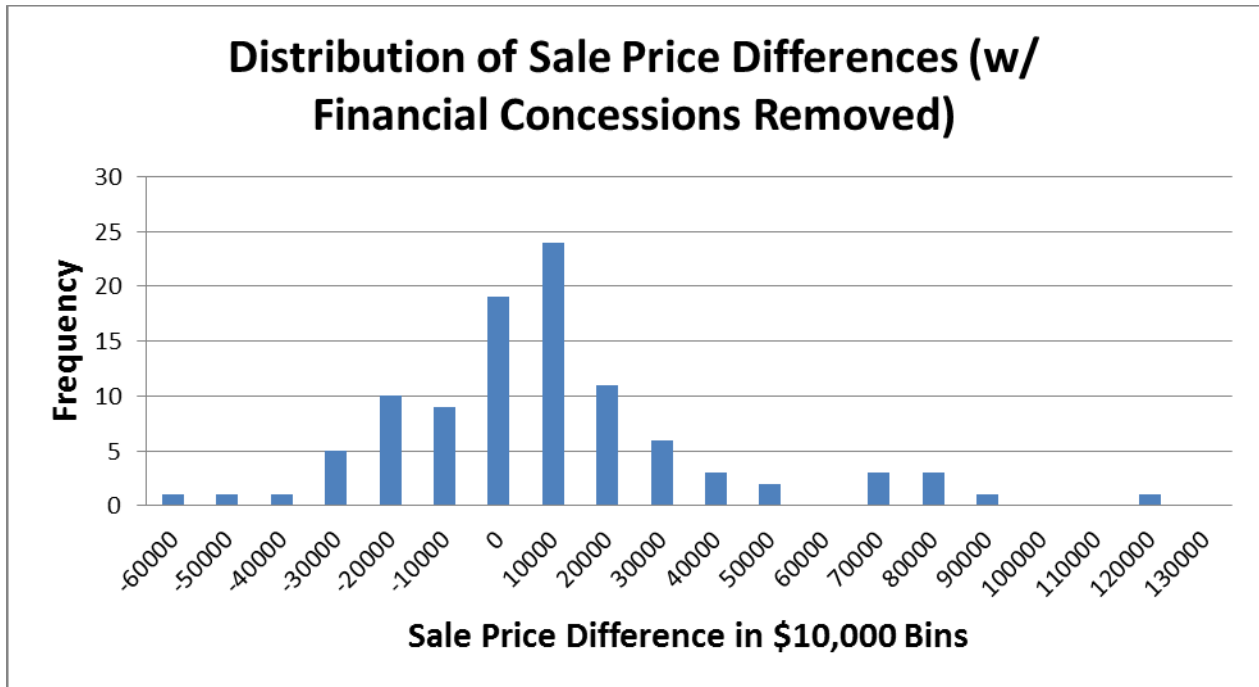


Figure 6. Frequency distribution of sale prices differences between ENERGY STAR and code-built homes after financial concessions are removed in \$10,000 increments.

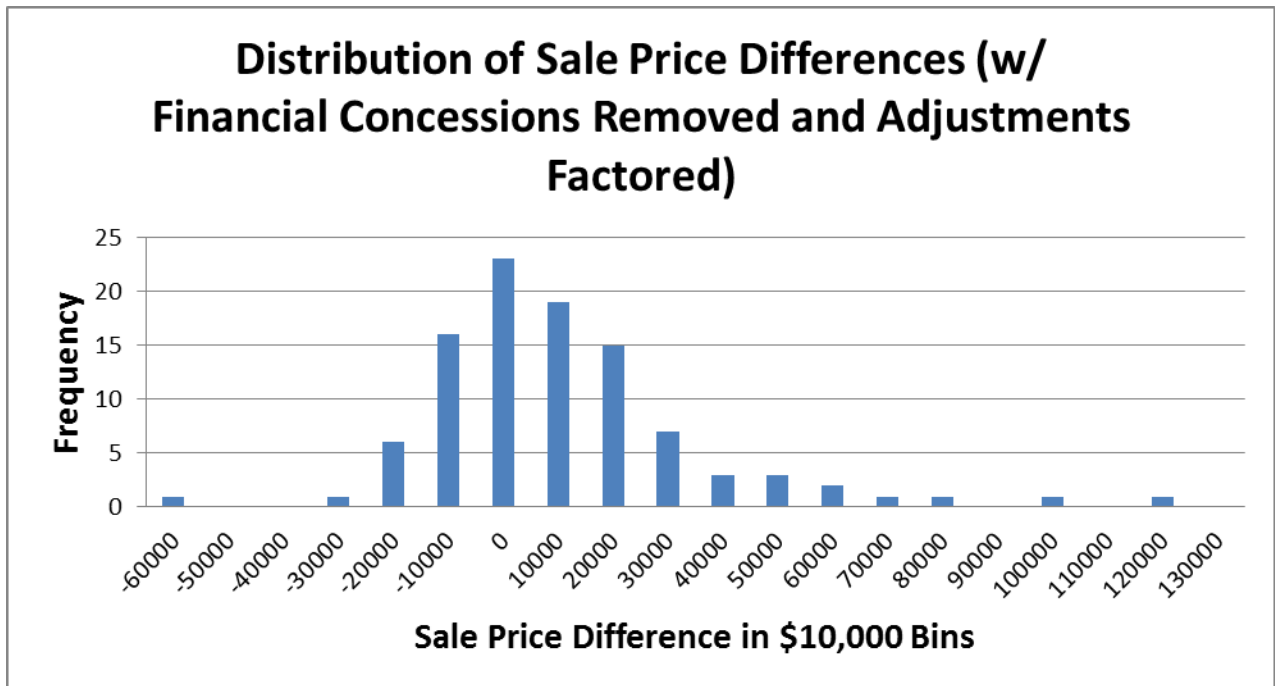


Figure 7. Frequency distribution of sale prices differences between ENERGY STAR and code-built homes after financial concessions are removed and financial adjustments are accounted for in \$10,000 increments.

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 sale 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 utilized. 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, 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,  $t(199) = 1.06$ ,  $p = \text{n.s.}$  ( $p = .1463$ ). ENERGY STAR Homes were found to sell for 0.45% more of

their list price compared to the code-build comp homes, but this difference was not great enough to produce a significant result. Similarly, when considering the proportion of the list price homes sold for 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,  $t(199) = 1.10$ ,  $p = \text{n.s.}$  ( $p = .1362$ ). Using this approach, ENERGY STAR Homes were found to sell for 0.48% more of their list price compared to the code-build comp homes. Results of the analyses and their distributions are shown in Figures 8-10. A summary of group means, standard deviations, mean differences, and t-test results including significance level and p-values can be found in Table 2.

**Table 2.** Proportion of list price analyses statistics including group means, standard deviations, group mean differences, and t-test results including significance level and p-values by analysis type.

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



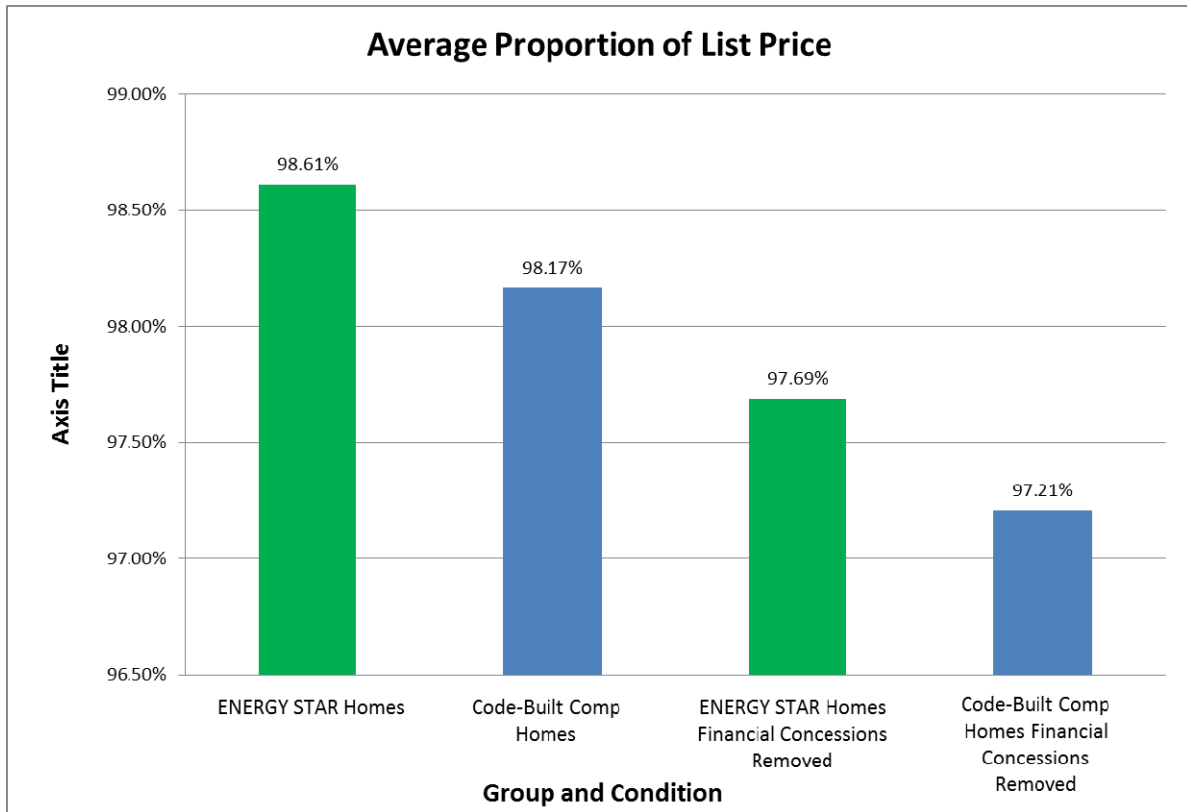


Figure 8. Group means of the proportion of list price ENERGY STAR and code-built homes sold for by group and condition.

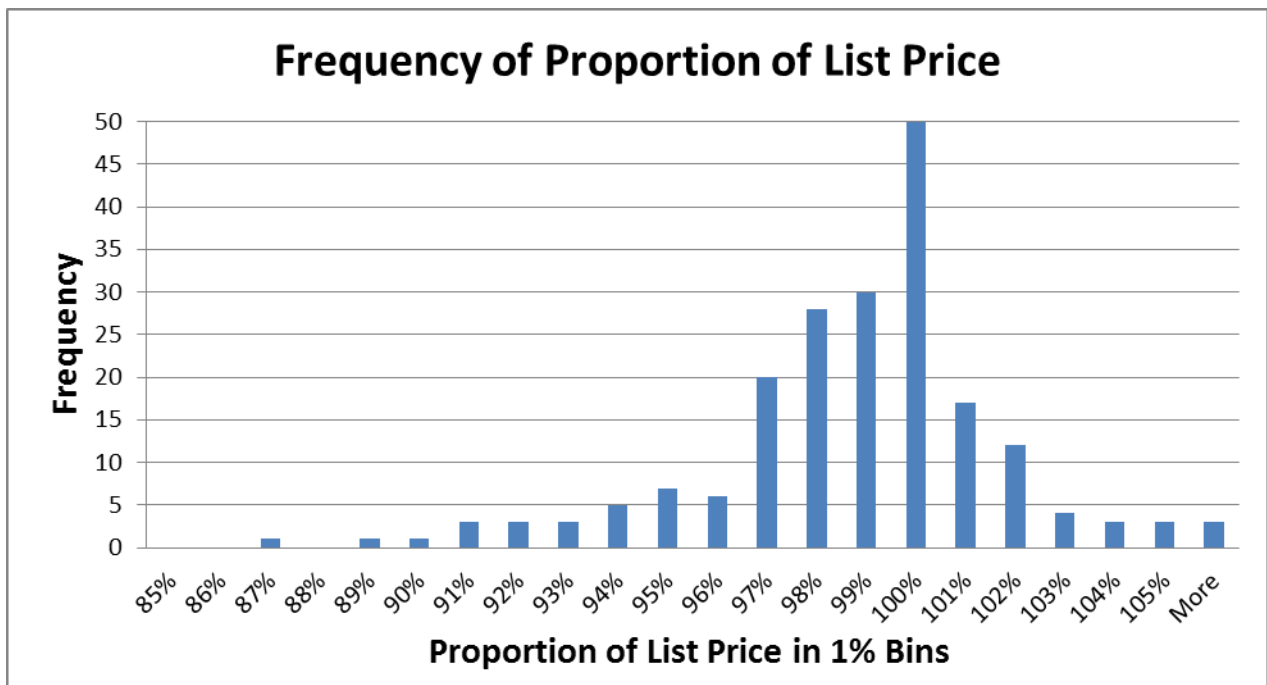
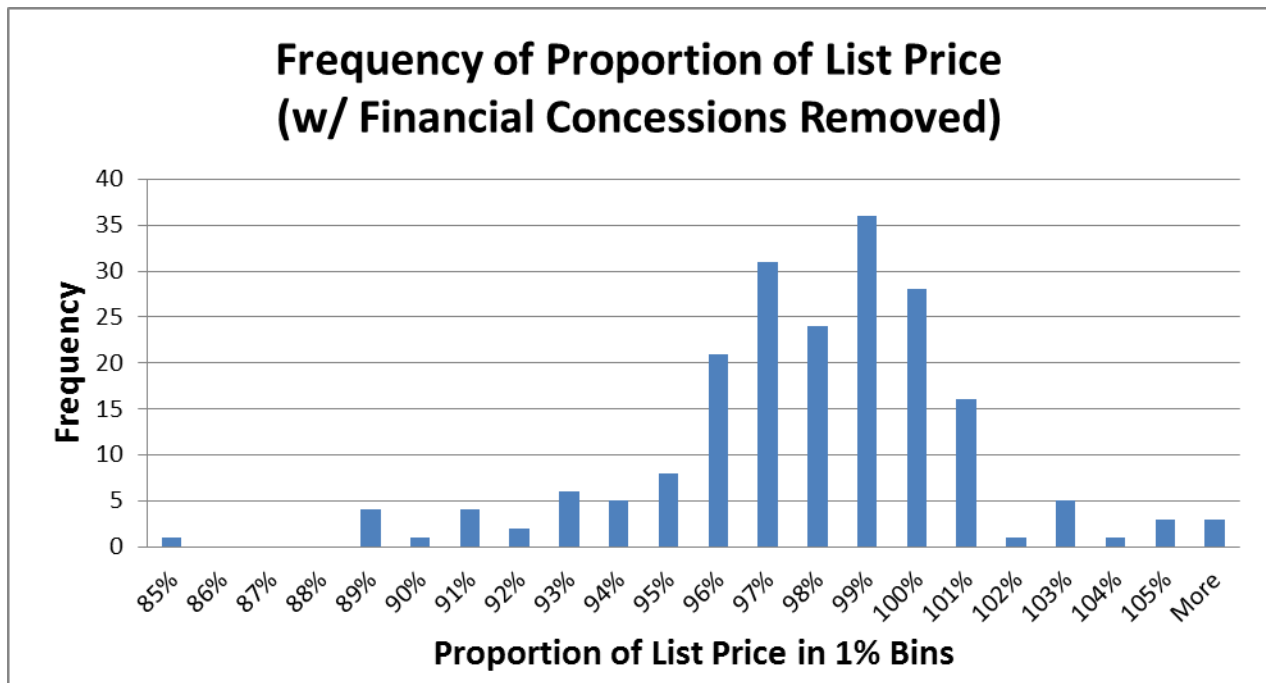


Figure 9. Frequency distribution of the proportion of list price ENERGY STAR and code-built homes sold for in one percent increments.



*Figure 10.* Frequency distribution of the proportion of list price ENERGY STAR and code-built homes sold for after financial concession were removed in one percent 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 are 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 ( $M = \$341,858$ ,  $SD = \$144,575$ ),  $t(199) = 0.8371$ ,  $p = \text{n.s.}$  ( $p = 0.2018$ ). 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 represent 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 thirty-year mortgage and their willingness to pay for energy efficiency. Research along these lines would provide greater insight into possible reasons 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

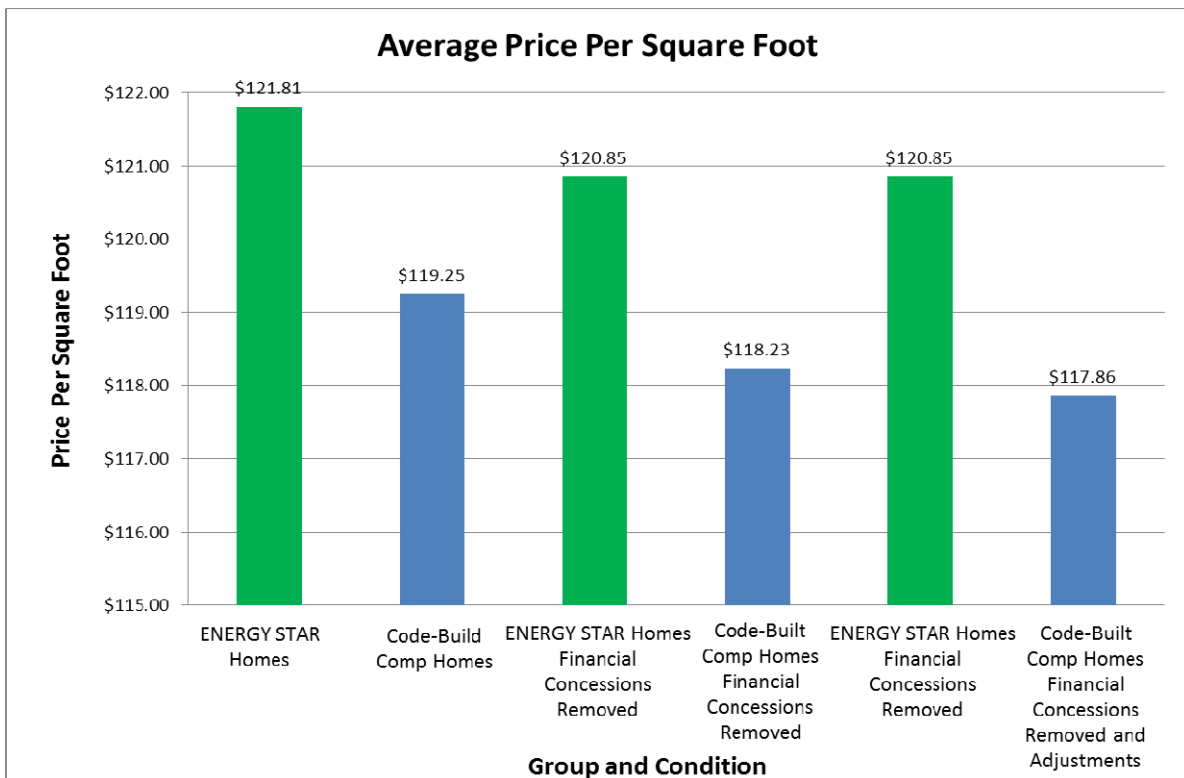
The price per square foot of a home is calculated by dividing a home's sale price by its reported conditioned square footage. Understanding the value of a home on a price per square foot basis is important because it creates a standard unit of measurement that can be equally applied to any home. Examining 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 is 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-build 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-build 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-build 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,  $t(199) =$ ,  $p < .05$  ( $p = 0.0129$ ). Results of the analyses as well as their distributions are shown in Figures 8-11. Results of the analyses, their distributions, and the distribution of sale price differences are shown in Figures 11-17. A summary of group means, standard deviations, mean differences, and t-test results including significance level and p-values can be found in Table 3.

**Table 3.** Price per square foot analyses 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)
<u>Price per Square Foot Analysis:</u>					
ENERGY STAR Homes	\$121.81	\$29.97	\$2.56	0.0350	0.05
Code-Built Comp Homes	\$119.25	\$23.59			
<u>Analysis w/ Financial Concessions Removed:</u>					
ENERGY STAR Homes	\$120.85	\$30.49	\$2.62	0.0337	0.05
Code-Built Comp Homes	\$118.23	\$24.06			
<u>Analysis w/ Financial Concessions Removed and Adjustments</u>					
ENERGY STAR Homes	\$120.85	\$30.49	\$2.99	0.0129	0.05
Code-Built Comp Homes	\$117.86	\$24.46			



**Figure 11.** Group mean comparison for price per square foot data for all three analytic approaches.

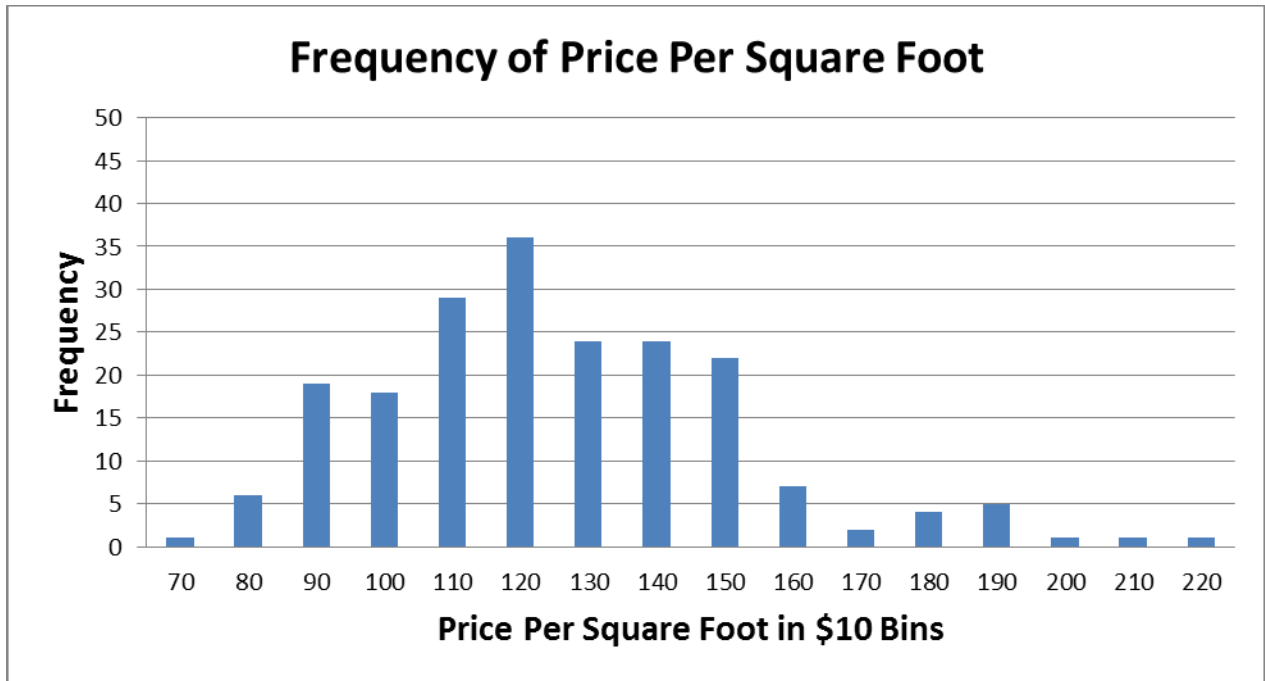


Figure 12. Frequency distribution of price per square foot of ENERGY STAR and code-built homes in bins of \$10.

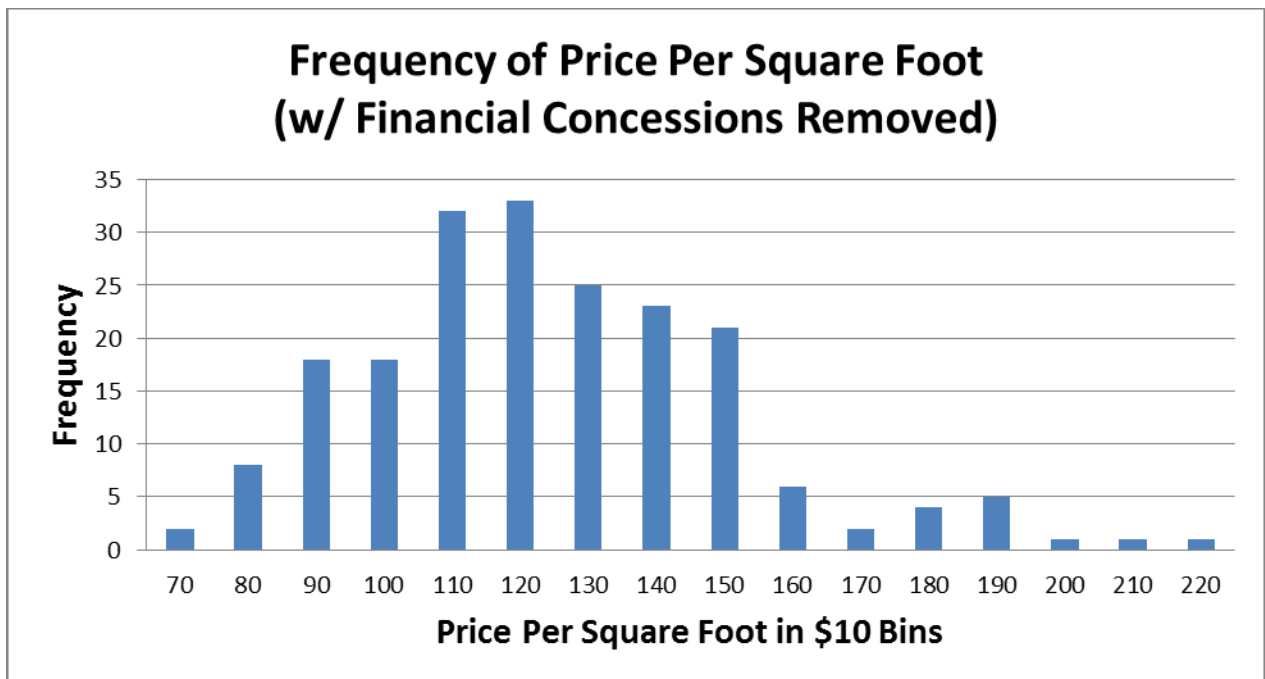


Figure 13. Frequency distribution of the price per square foot that ENERGY STAR and code-built homes sold for after financial concessions were removed in bins of \$10.

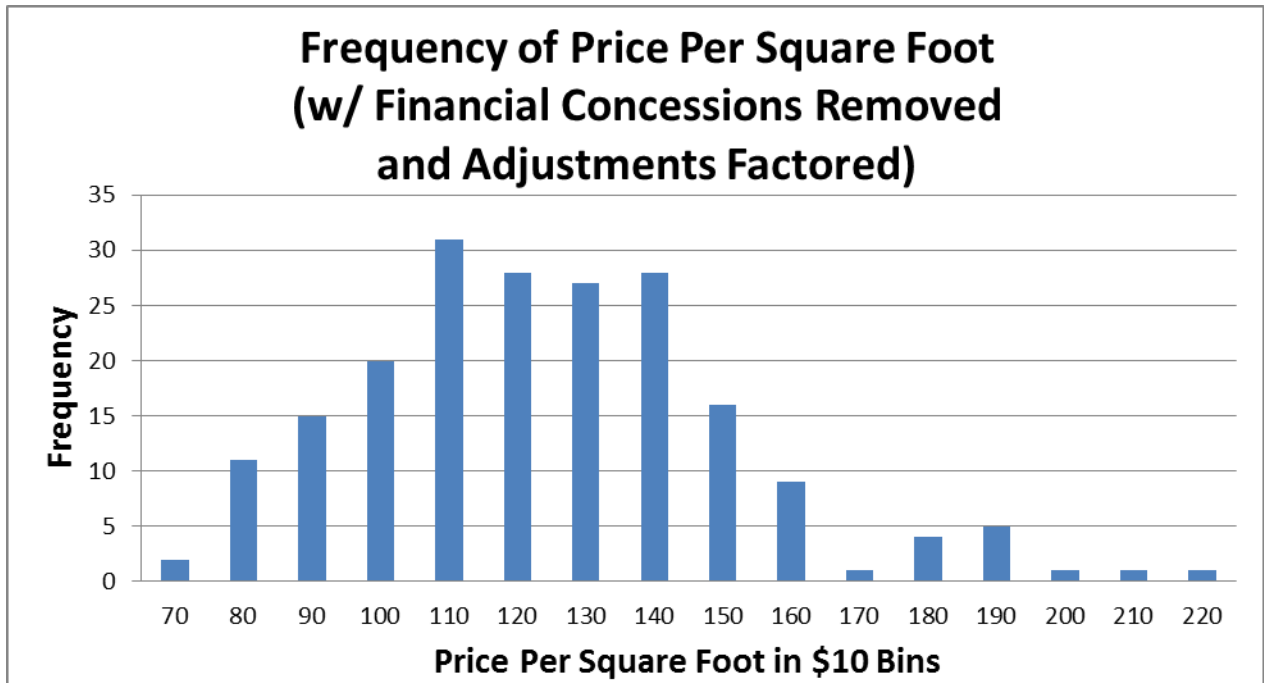


Figure 14. Frequency distribution of the price per square foot that ENERGY STAR and code-built homes sold for after financial concession were removed and adjustments were considered in bins of \$10.

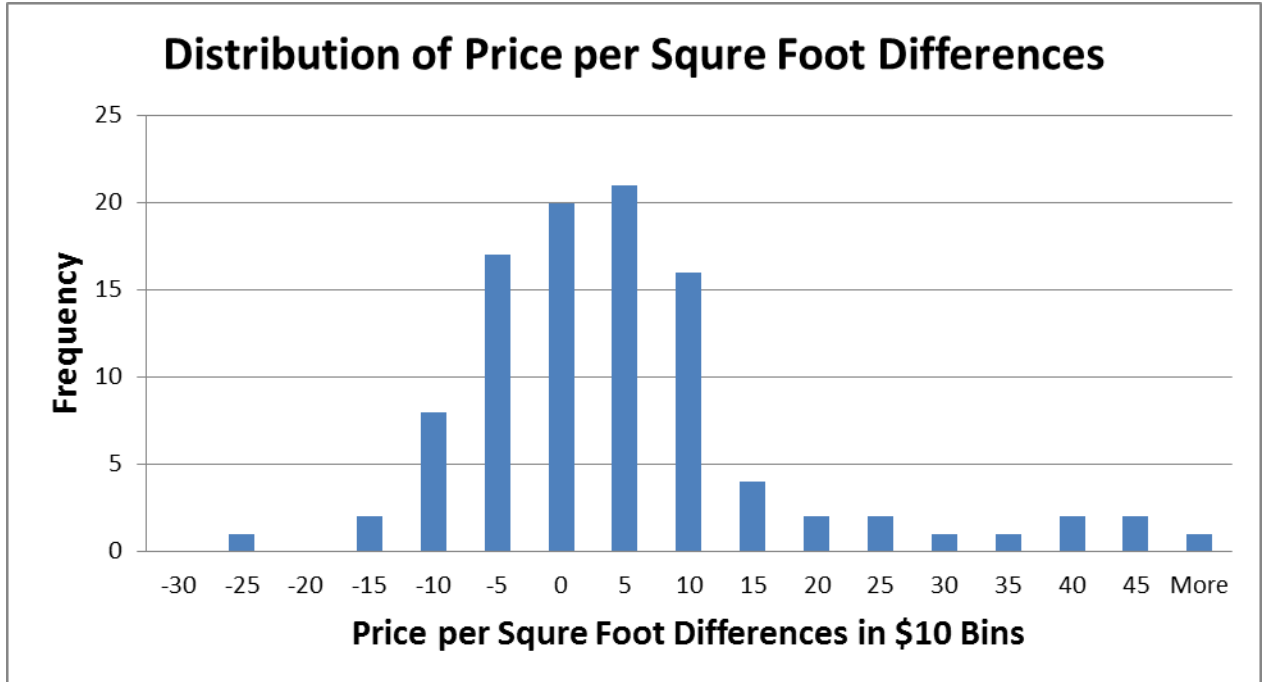


Figure 15. Frequency distribution of price per square foot differences between ENERGY STAR Homes and code-built comp homes in \$5.00 increments.

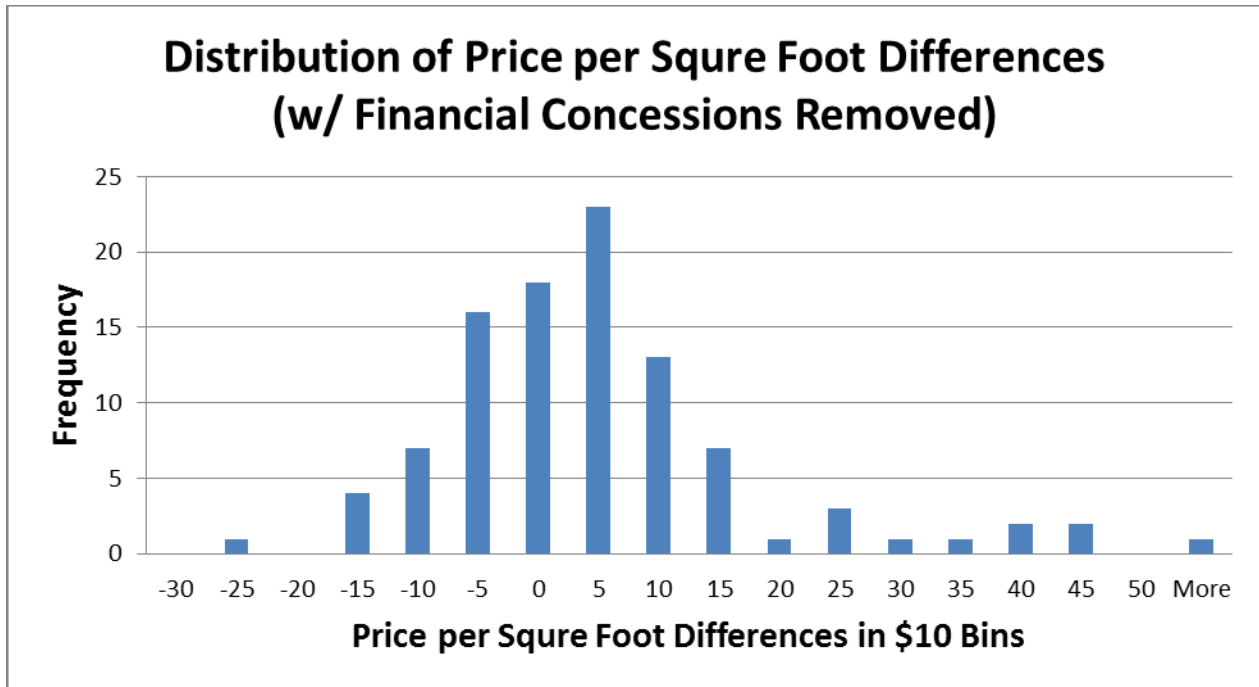


Figure 16. Frequency distribution of price per square foot differences between ENERGY STAR and code-built homes after financial concessions are removed in \$5.00 increments.

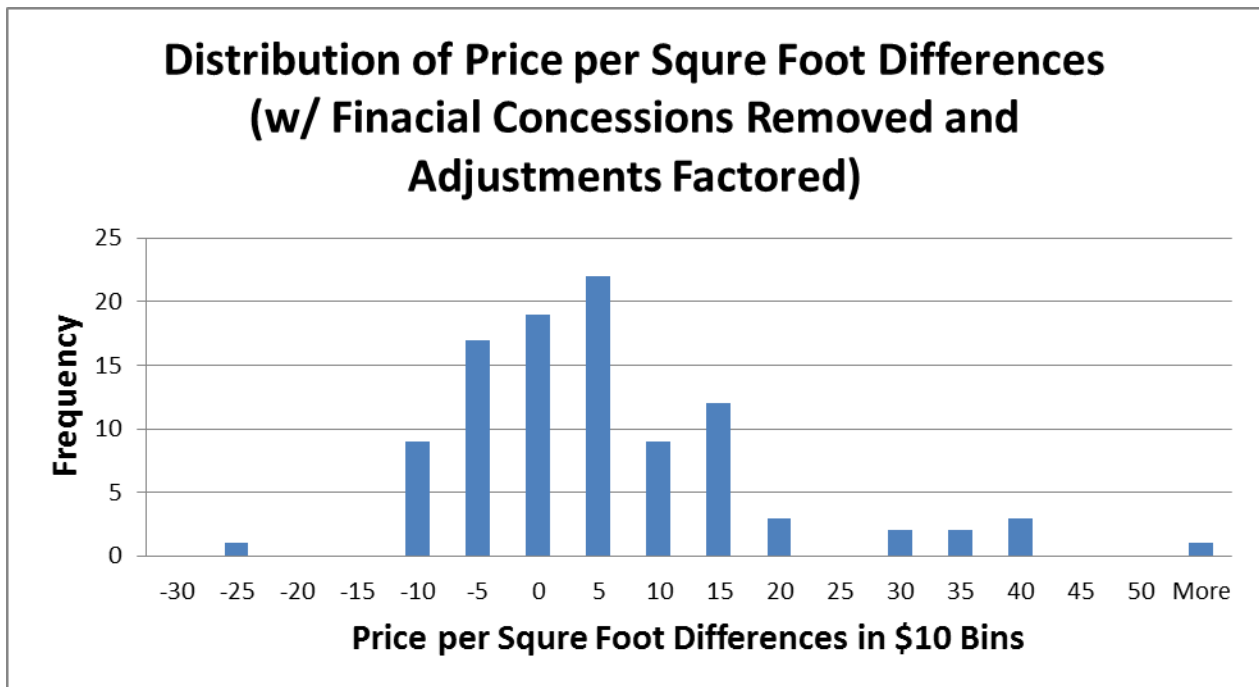


Figure 17. Frequency distribution of price per square foot differences between ENERGY STAR and code-built homes after financial concessions are removed and financial adjustments are accounted for, in \$5.00 increments.



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 has spent on the market. This number may not be a perfect indicator and could still underestimate the true time a home has 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 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 sample homes spent on the market, an overwhelmingly robust difference is 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 analysis, their distributions, and the distribution of sale price differences are shown in Figures 18-21. A summary of group means, standard deviations, mean differences, and t-test results including significance level and p-values can be found in Table 4.

**Table 4.** Days on market analysis 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)
<u>Sale Price Analysis:</u>					
ENERGY STAR Homes	98	117.88	89	0.000002	0.01
Code-Built Comp Homes	187	145.63			

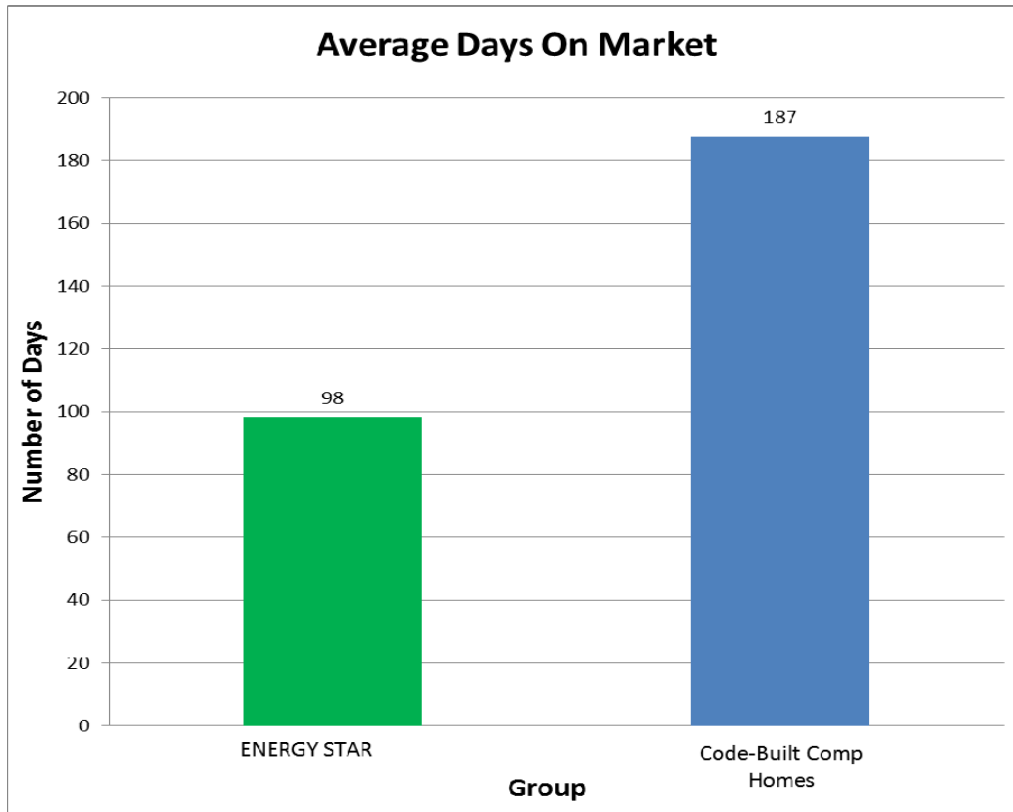


Figure 18. Group mean comparison for days on market data.

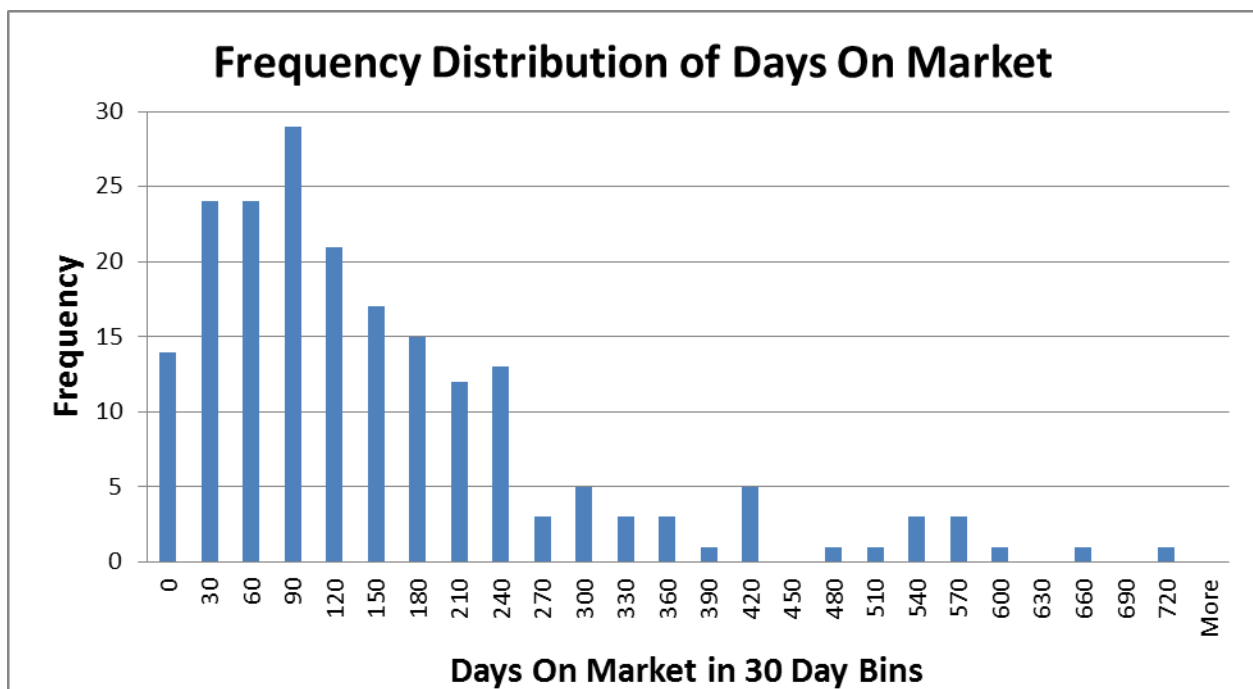


Figure 19. Frequency distribution of the days spent on the market by ENERGY STAR and code-built homes together in bins of 30 days.

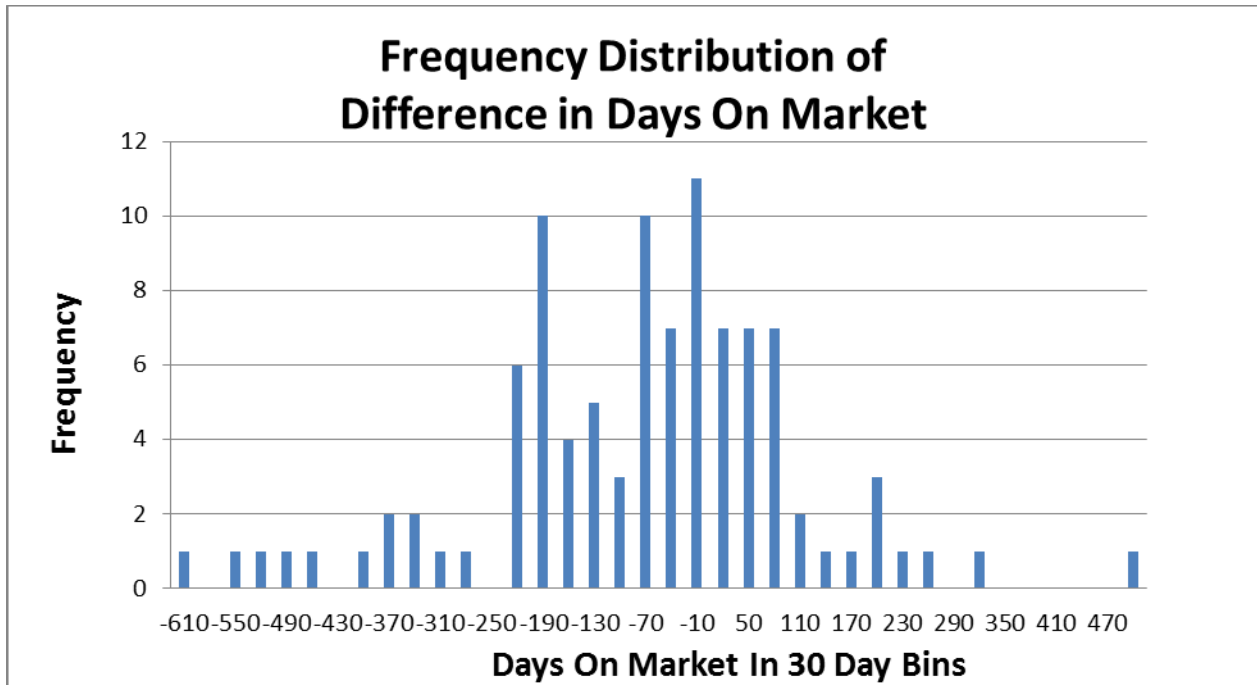


Figure 20. Frequency distribution of the differences in the days spent on the market between ENERGY STAR and code-built home in 60 days bins.

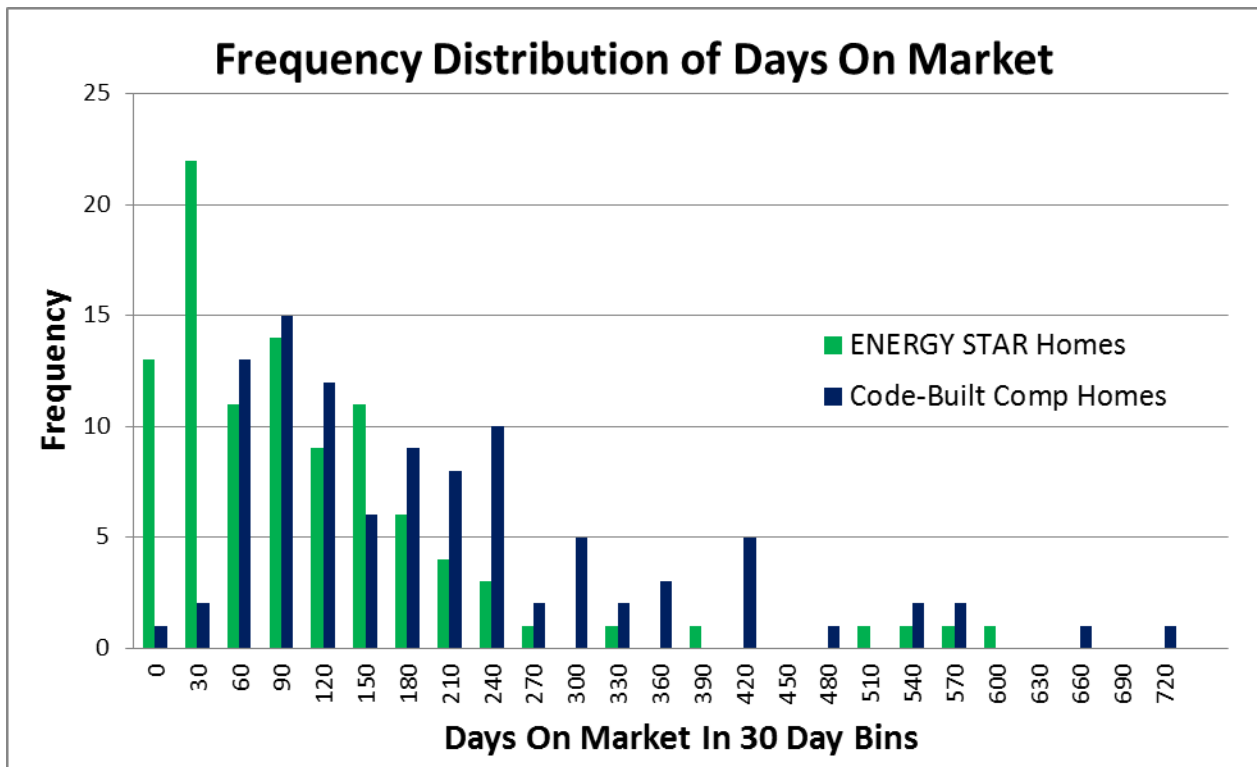


Figure 21. Frequency distribution of the days spent on the market by ENERGY STAR and code-built homes separated in bins of 30 days. Note the ENERGY STAR distribution is shifted left and has a pronounced difference in the number of homes selling in under 30 days and has far fewer homes needing over 180 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 indicate 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.

## Conclusion

The ENERGY STAR Homes sampled for the investigation demonstrated a significant market advantage in three of the four analyses carried out when compared against the code-built comp homes. Interestingly, evidence of market advantages surfaced even when differences between groups were not minimized. This evidence was found when the financial adjustments made by the third-party appraisal company (for the purpose of best controlling for differences between the properties) were not considered in the analysis. However, where applicable, when the differences between ENERGY STAR Homes and their code-built counterparts were minimized through the appropriate use of these financial adjustments, the strongest evidence signifying ENERGY STAR Homes' market advantage was exemplified. It was found that when the differences were minimized, ENERGY STAR Homes sold for an average sale price premium of \$5,566 per home and \$2.99 more per square foot over the code-built comp homes. Additionally, ENERGY STAR Homes sold an average of 89 days faster than the code-built comp homes. On average, ENERGY STAR Homes also sold for 0.48% greater as a proportion of the list price compared to the 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 a strong, multidimensional market advantage when compared with similar code-built homes.

### Implications for Home buyers

At first glance, these results may seem problematic for the average home buyer. That is, this study 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, while it was found that ENERGY STAR Homes sold for more money, real estate agents and builders were not initially asking for more despite the many additional and beneficial features that are built into the qualification process. Likewise, the up-front cost savings gained by choosing a non-certified home is quickly negated by immediate positive cash flow due to energy savings. Additionally, the implications of days spent on market will likely transfer to a quicker turnover for that homeowner when they sell their home in the future.

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 around five years. If looked at in terms of a thirty-year mortgage, using the common rule of thumb, for every \$1,000 lent one can expect to have approximately \$1 of additional monthly mortgage payments, ENERGY STAR Homes can produce a positive cash flow. This positive cash flow 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 study 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 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; and Nevin & Watson, 1998) have found that more efficient homes sell for higher sale prices. Moreover, the appraisal industry may be convinced by this 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. Sampled ENERGY STAR Homes were found to sell 89 days faster than non-certified homes. If this trend is generalized to any home sale, ENERGY STAR homeowners could 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, facilitate relocation, and reduce 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 sampled for this study, home builders should have multiple avenues for recouping additional investments required in 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. This means higher profits for home builders and larger commissions for their real estate agents. ENERGY STAR Homes also sell significantly faster than non-certified homes, meaning less carrying costs for home builders and less time investment for real estate agents, freeing them to focus on other listings. Moreover, the home builder/real estate agent team may take satisfaction in offering the consumer a product that will provide them a more enjoyable living experience, is more environmentally responsible, is a higher quality product, and one that will ultimately save the consumer money. These less direct, consumer-related benefits could circle back to the home builder or real estate agent by decreasing warranty claims and increasing 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 a 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 larger mortgage amounts. Additionally, if the



benefits of energy-efficient home features are ignored in the appraisal report, the loan amount may not be enough to cover the additional cost of those features, putting more efficient homes outside of financial reach for some home buyers. Therefore, because the appraisal report has not assigned an appropriate value to these features, this 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; and 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 (Carson, 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 this study 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 ignored during the appraisal process. This recurrent theme 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 upfront 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 comparable homes. 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 ENERGY STAR homes attained higher sales prices and sold in significantly less time compared with similar conventional 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 and even profitable.

Findings of this study also contain implications for the lending and appraisal 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 this study have a high degree of statistical significance in the greater Raleigh, NC housing market, replication of this methodology should be conducted in other markets to further validate the robustness of this statistical analysis. Understanding these real market impacts and assigning appropriate value to energy efficient construction techniques may help facilitate widespread implementation of energy-efficient building certification programs on a national scale. Implications of these results should be capitalized on by many of the housing market's key stakeholders including home buyers, home builders, real estate agents, appraisers, and lenders.

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