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Value added to small residential homes due to energy efficiency measures

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Energy efficiency has become one of the preferred features for homebuyers. Today, energy-efficient houses are valued more on the housing market since there is a significant emphasis on environmental consciousness. Energy-efficient homes are rated as superior homes due to their role in reducing utility bills. Fannie Mae, Freddie Mac, and Federal Housing Administration (FHA) have developed policies and guidelines to help appraisers assess the energy-efficient features of a home. However, the appraisers do not generally add value of energy-efficient measures due to difficulties in estimating the benefits. The home appraisers will welcome a tool that could help them estimate the benefits of an energy efficiency measure and will use it in their appraisals. The tool developed in this study will consider the most common home energy efficiency measures (EEMs) in four categories: space conditioning, hot water, enclosures, and lighting/appliances, and estimate the initial cost of adding them to a home as well as their annual energy savings. Spreadsheets are developed for a small size home in Gainesville, Florida that allow the home appraisers find the present worth of an added energy efficient measure based on the remaining life of the home, the energy inflation rate, and the discount rate.

Keywords: Home Appraisal, Energy Efficiency Measures, Energy Saving, Payback Period

Introduction

Home appraisal is normally considered an unbiased professional estimate of the fair market value of a home or property and is ordered by lenders during the mortgage loan process. The lender's goal is to make sure that the amount of money requested by the borrower is proper (Fontinelle, 2019; Williamson, 2022). However, this procedure is often difficult, an error-prone attempt, and time consuming. Many lenders such as banking institutions want to achieve a precise appraisal of a building, home, or other commercial or residential properties (Williamson, 2022). Without an accurate appraisal, there is no guarantee for lenders to know if they are lending the fair amount for the property, and there is no way for borrowers to understand if they are paying a fair market value for the home (Homes, 2019). A home appraisal is a key part of the transaction whether using a mortgage, refinancing the existing mortgage, or selling the home to a person other than all-cash buyers. The owner, buyer, or seller needs to know how the appraisal process works and how appraisers assess a home's value. Indeed, the appraiser should normally be hired by the lender, and the appraisal fee which could be several hundred dollars is

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generally paid by the borrower (Fontinelle, 2019). Energy-efficient homes should sell for higher prices due to the added value of energy efficiency features and the lower utility bills for homeowners. Fannie Mae, Freddie Mac and FHA guidelines require appraisers to consider the energy efficient features of the home and make an adjustment in the appraised value. However, energy efficiency can be overlooked in the appraisal process due to appraiser qualifications and a lack of access to quality data. Doyle and Bharagava (2012) reported numerous challenges to develop adequate valuation for energy efficiency, such as the lack of valuation sources for energy efficiency improvements and lack of collaboration between stakeholders. They concluded that proper valuation would encourage investment in energy efficiency, create jobs, and increase energy independence benefits. On July 28, 2022 a legislation named “Getting Renewable and Energy Efficient Neighborhoods (GREEN) Appraisals Act” was introduced in the U.S. House and Senate to encourage energy efficient and renewable features to be considered as part of the residential homebuying and appraisal process. This legislation is aimed at ensuring home appraisals accurately reflect the value of renewable and energy efficient features of a property (GovTrack, 2022). Appraising energy-efficient homes when there are so few comparable and the homes are equipped with heat pump water heaters, low E windows, LED lights, and EnergyStar appliances is a huge task.
The goal of this paper is to provide appraisers with a tool that could help them estimate the benefits of an energy efficiency measure and use it in their appraisals. The tool developed in this study will allow the home appraisers to find the present worth of an added energy efficient measure based on the remaining life of the home.

Background

Home Appraisal

An appraisal should protect the interests of both the borrower and the lender. The appraisal can cover the current condition of the property, recent sales information for similar properties, the location of the property, i.e., insight as to how the neighborhood affects the property's value (Williamson, 2022). The most important tool an appraiser uses during appraisal is comparable sales. This mentions the prices of homes of a similar size, age, and construction to the property being appraised that have recently been sold in the same neighborhood (Thompson, 2018).

Appraisals are usually performed by specially trained professionals who are certified to assess the value of a home objectively and impartially. An appraiser must be a specialist on the housing market and be familiar with the local market circumstances. While no appraiser is flawless, his or her opinion of the value of the home is often informed by training, numerous tests, years of experience and required continuing education. Appraisers are also required to prove every finding in their reports that could have impact on home's value (Appraisal Institute, 2019; Fontinelle, 2019; Williamson, 2022). It is understood that the appraiser does not work for the interests of anyone, because their only job is to evaluate the property and give a reasonable estimate of its worth (Homes, 2019).

While price, location, and design are a home buyer’s major considerations (Appraisal Institute, 2019), the appraisal is generally based on the property's physical characteristics such as the number of bedrooms and bathrooms, square footage, location, age, lot size, and view (Hewes & Peeks, 2013; Williamson, 2022). The appraiser checks the inside factors such as functional layout and how well the space is designed, the size of major rooms such as the kitchen in comparison to the magnitude of the other rooms, the electrical, mechanical, and plumbing systems, safety and health matters like fire escapes and handrails, and the quality and number of home appliances.

Energy Efficiency

Energy Efficient Homes

A notable amount of energy consumption comes from the residential sector, which was around 17 percent of total energy usage in the United States in 2020 (U.S. Energy Information Administration, 2021). Building activities consume more than 30 percent of worldwide energy production and emit over 30 percent of the process-related global greenhouse gases (Fenner et al., 2020). Therefore, energy efficiency is one of the most advisable home features which buyers are willing to pay more for (Appraisal Institute, 2019; EnergySage, 2018). Electric heater, air conditioner, water heater, and electronics account for the main parts of a home's energy bill, therefore it is necessary to decrease the energy usage of these parts. Figure 1 shows the share of electric consumption for a typical house in U.S.

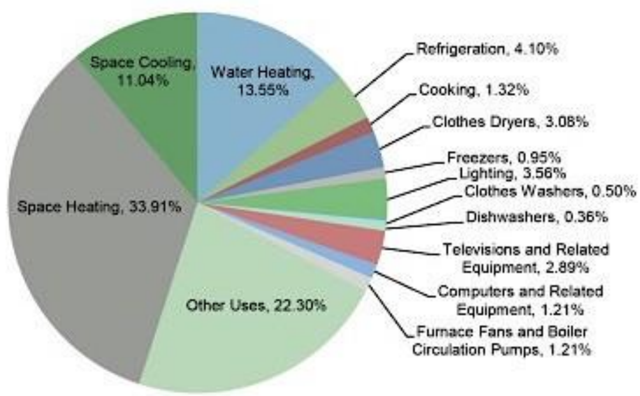

Figure 1. U.S. Residential Energy Consumption by End Use, 2019 (Source: Energy Information Administration, 2020)

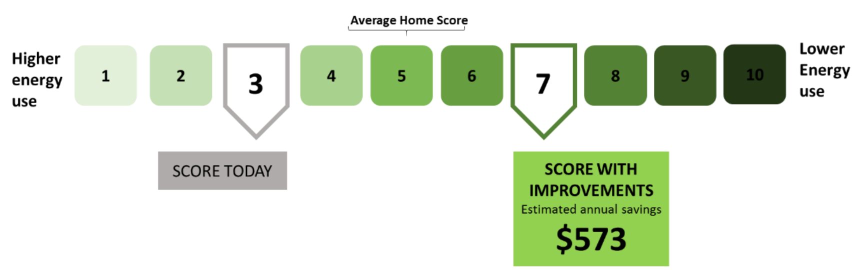

Figure 2. The relation between home energy score and energy consumption (U.S. Department of Energy, 2016)

Energy Efficiency Measures (EEMs)

The site conditions, occupant behavior, and climate are some of the factors that affect the energy consumption of homes. In addition, there are some measures that reduce energy use of homes, which are called Energy Efficiency Measures (EEMs). The four major categories for EEMs are space conditioning, hot water, enclosures, and lighting/appliances (Burge, 2016; Talbot, 2012).

The U.S. Department of Energy (DOE) established a national rating system to improve energy efficiency of homes. A score of one to ten is assigned to a home, where the score of ten represents the most efficient home. The score is mainly based on the building envelope, cooling, heating, and hot water. Figure 2 demonstrates that higher scores cause lower energy consumption (U.S. DOE, 2016).

The other approach to reduce energy consumption is to design homes based on national model energy codes such as those that are developed by ASHRAE and the International Codes Council (Athalye et al., 2016; Cohan, 2016). Homes built based on the 2012 or 2015 International Energy Conservation Code (IECC) are around 15 percent more energy efficient and have lower monthly utility bills than the previous codes. One of other strategies to improve energy efficiency of homes is the “ENERGY STAR” certification, which is established by the Environmental Protection Agency (EPA) in 1992. ENERGY STAR certified homes are at least 10% more energy efficient than non-certified homes (energystar.gov).

The other energy efficiency rating system is the Home Energy Rating System (HERS) Index by the Residential Energy Services Network (RESNET). A certified Home Energy Rater assesses the energy efficiency of a home by calculating its energy use for several end-uses such as heating, cooling, and water heating and assigns a relative performance score. The lower the number, the more energy efficient the home. A home with a HERS Index Score of 130 is 30% less energy efficient than a standard new home. The U.S. DOE has determined that a typical resale home scores 130 on the HERS Index while a standard new home is awarded a rating of 100.

Policies and guidelines to include EEMs in home appraisal

The Federal National Mortgage Association, commonly known as Fannie Mae, is a U. S. government-sponsored enterprise and, since 1968, a publicly traded company. Whether to buy or refinance a home, Fannie Mae presents HomeStyle® Energy mortgage loan to improve energy and water efficiency and decrease utility costs. This type of loan may be the most affordable financing way for energy-efficient purposes (Fannie Mae website).

The Federal Housing Administration is a U. S. government agency created in part by the National Housing Act of 1934. The FHA sets standards for construction and underwriting and insures loans made by banks and other private lenders for home building. In 1992, the Department of Housing and Urban Development (HUD) launched the Energy Efficient Mortgage as a pilot program in five states and developed it into a national program in 1995. FHA's Energy Efficient Mortgage program (EEM) encourages homeowners to reduce utility costs by financing energy-efficient upgrades with their FHA-insured mortgage. Cost-effective energy upgrades can decrease utility bills and gain more income available for the loan payment (FHA website).

The Federal Home Loan Mortgage Corporation, known as Freddie Mac, is a public government-sponsored enterprise. Freddie Mac offers the GreenCHOICE Mortgage® loan to assist homeowners in keeping their home affordable over time by reducing their utility bills. Freddie Mac provides financing for energy-efficient changes with long-term mortgage payments (Freddie Mac, 2021). The recent

Freddie Mac report demonstrates that the homes, which are rated by different energy efficiency rating systems like HERS Index are sold more than the similar unrated houses. Indeed, the houses, which are rated better could be sold 3-5 percent more than the lesser-rated homes (Argento, et.al, 2019).

Appraising a high-performance home

In 2011, in response to growing concerns that standard appraisal forms are not set up to give adequate recognition to costly energy-conservation improvements the Appraisal Institute published "the Residential Green and Energy Efficient Addendum." The addendum that should be attached to any standard appraisal report covering a high-performance property requires the appraiser take notice of energy efficiency improvements and seek a value adjustment consistent with the local market conditions (Washington Post, 2011). The addendum relies on properly trained third-party professionals to test and report on the energy efficiency improvements used at home because very few appraisers are trained to complete the addendum accurately (Fincham, 2020). The third-party verification section is pre-filled with a few common certification organizations (EPA Energy Star, DOE Zero Energy Home, USGBC LEED, Living Building Certified, etc.) and energy labels (RESNET's HERS, DOE's Home Energy Score) to select from.

A 2015 appraiser-led study in Washington, D.C. found that homes with high-performing features sell for an average premium of 3.46% compared to homes without these features (Adomatis, 2015). A 2017 study on homes sold in Northern and Central Virginia found that the average price premium for a certified high-performance home was more than 5% when compared to non-certified homes (Adomatis, 2017). A 2018 study in the Bay Area found that high-performance homes with a third-party verification have, on average, a selling price 2.19% higher than non-certified homes (Adomatis, 2018).

The challenge for the appraisers is to calculate the value the energy efficient improvements bring to real estate transactions. In other words, if there is an added value associated with the sale of homes with high-performing features, how can the appraiser obtain the data and information required to calculate such a premium? The goal of this paper is to provide appraisers with a tool that could help them estimate the benefits of an energy efficiency measure and use it in their appraisals.

Methodology

In a previous study (Fenner, 2019), an energy model was developed for a 1204 SF baseline modular home in Climate Zone 2A (hot-humid climate). The baseline home was a one-story, 28 ft wide and 43 ft long with three bedrooms, two bathrooms, 8 ft ceiling height, and 4:12 gable roof located in Gainesville, Florida. Energy consumption of the baseline home was calculated using BEopt™ (Building Energy Optimization Tool). The BEopt™ is a computer program designed by the National Renewable Energy Laboratory to optimize energy efficiency models along the path to Zero Net Energy homes. In addition to Climate Zone and the baseline modular home characteristics (SF, width and length, ceiling height, number of bedrooms/bathrooms, and roof slope), the thermophysical and equipment properties of the house (orientation, R values for walls and roof, size and properties of windows, lighting fixtures, properties of air conditioning system, water heaters, and appliances) were needed to use BEopt™ 2.8.0 software. The output included the baseline construction cost and its annual energy consumption.

Next, the baseline home was upgraded with the following energy efficiency measures to meet the 2018 International Energy Conservation Code (IECC 2018):

- Increasing wall insulation from R-13 to R-21

- Increasing roof insulation from R-30 to R-38
- Reducing Ufactor and SHGC for windows from 0.35 and 0.44 to 0.34 and 0.30, respectively
- Reducing infiltration from 5 Air Change Per Hour at 50 Pa (ACH50) to 4.5 ACH50
- Increasing air condition SEER from 13 to 16
- Changing water heater from an electric standard to a 50-gallon Heat Pump Water Heater
- Changing lighting from 100% incandescent to 100% LED
- Changing the baseline appliances to EnergyStar appliances

BEopt™ was used for each EEMs individually (wall insulation, roof insulation, etc.) to identify the energy savings and costs associated with adding each EFMs. The next step was to use BEopt™ to simulate all features together to determine the total energy savings of the IECC 2018 home compared to the baseline home. Ultimately, by developing a spreadsheet the present worth of each EEMs was calculated considering the remaining life of the home, and the discount and energy inflation rates.

Under the cost analysis, the initial construction costs and the simple payback period were calculated. The initial construction cost refers to the costs associated with the materials, equipment, and labor needed to manufacture the baseline home and add each EEMs. The average national prices for materials and installation (R. S. Means 2019) were adjusted for the location of the house, Gainesville, FL. The literature and interview with manufacturers of modular homes revealed that materials cost for modular homes are 10% less than site-built residential homes due to bulk purchase. In addition, installation cost for modular homes is considerably less than site-built homes due to higher labor productivity (controlled environment, repetition of similar activities, and working on the factory floor rather than working at heights) and using more advanced tools and equipment. The decrease in labor cost reported varied as low as 33% and as high as 50%. For this study a 40% reduction in installation cost was considered.

The simple payback period refers to the time required to recover the project investment without considering the time value of money. It is often defined as the break-even point, i.e., the year at which initial investment is offset by the benefits accumulated, which in this case was the energy-associated costs.

Results and Discussion

The construction cost for the upgraded home is $70,967, which is $5,947 more than the baseline home. This results in a 7.2-year simple payback period, which means that the additional investment for upgrading all EEMs will return after 7.2 years due to the lower energy bills resulted from the upgrades. By using BEopt™ the annual energy consumption for the base home and upgraded home were found to be 9,894 kWh and 4,958 kWh, respectively. Table 1 shows the amount of annual energy savings (kWh/year), annual reduction in energy bill ($/year), construction costs, and simple payback period for each EEM.

A spreadsheet was developed to help appraisers estimate the value added to a home due to inclusion of an energy efficiency measure. This value is a function of the annual energy savings (kWh), electricity cost ($/kWh), energy inflation rate, discount rate, and the remaining life of the home. Table 2 shows the value added to the home of this study for each EEM considering electricity cost of $0.17 per kWh and energy inflation rate of 5%. The value added are shown for 10- and 20-year remaining life and discount rates of 1 to 5%. For example, by upgrading wall insulation from R-13 (2x4 stud at 16 in o.c.) to R-21 (2x6 stud at 24 in o.c.), an energy saving of $44 per year can be achieved (Table 1).

Table 1

Energy savings, costs, and simple payback period for each energy efficiency measure

EEM	Energy Savings (kWh/year)	Energy Savings ($/year)	Initial Cost $	Simple Payback (year)
Walls	260	$44	$405	9.2
Ceiling	114	$19	$403	20.8
Window	85	$14	$268	18.5
Infiltration	155	$26	$262	10.0
Water Heater	1,459	$190	$1,501	7.9
HVAC	1,831	$311	$2,429	7.8
Dishwasher	93	$16	$141	8.9
Clothes Washer	381	$65	$127	2.0
Refrigerator	61	$10	$19	1.9
Clothes Dryer	219	$37	$176	4.7
Lighting	791	$134	$216	1.6
All Measures	**4,891**	**$831**	**$5,947**	**7.2**

Assuming a discount rate of 3% and the remaining life of 20 years, the appraiser can increase the value of the home by $1,088 (Table 2). The values in Table 2 may be converted to dollar per square foot to allow use of the table for homes with three bedrooms, two bathrooms, and 8 ft ceiling height located in hot-humid climates.

Table 2

The value added to the home appraisal value due to implementation of energy efficiency upgrades for 10- and 20- year remaining life, discount rates of 1 to 5%, electricity cost of $0.17 per kWh, and energy inflation rate of 5%.

Parameters	Remaining Life = 10					Remaining Life = 20				
	1%	**2%**	**3%**	**4%**	**5%**	**1%**	**2%**	**3%**	**4%**	**5%**
Walls	$551	$520	$492	$466	$442	$1,363	$1,215	$1,088	$979	$884
Ceiling	$241	$228	$216	$204	$194	$597	$533	$477	$429	$388
Window	$180	$170	$161	$152	$145	$446	$397	$356	$320	$289
Infiltration	$328	$310	$293	$278	$264	$812	$725	$649	$564	$527
Water Heater	$3,090	$2,919	$2,761	$2,615	$2,480	$7,467	$6,820	$6,108	$5,493	$4,961
HVAC	$3,878	$3,663	$3,465	$3,282	$3,113	$9,597	$8,559	$7,665	$6,894	$6,225
Dishwasher	$197	$186	$176	$167	$158	$487	$465	$389	$350	$316
Washer	$807	$762	$721	$683	$648	$1,997	$1,871	$1,595	$1,435	$1,295
Refrigerator	$129	$122	$115	$109	$104	$320	$285	$255	$230	$207
Dryer	$464	$438	$414	$393	$372	$1,148	$1,024	$917	$835	$745

Lighting	$1,675	$1,583	$1,497	$1,418	$1,345	$4,146	$3,697	$3,611	$2,978	$2,689
All Features	**$10,359**	**$9,786**	**$9,256**	**$8,767**	**$8,315**	**$25,635**	**$22,862**	**$20,476**	**$18,415**	**$16,629**

Conclusions

Appraisers should consider the value added to homes due to energy efficient upgrades because they reduce energy consumption of the home and lower energy bills for homeowners. Fannie Mae, Freddie Mac and FHA guidelines require appraisers to consider the energy efficient features of the home and make an adjustment in the appraised value. However, energy efficiency can be overlooked in the appraisal process because of difficulties in determining the amount of added value. The approach used in this paper was to determine the energy savings and construction costs associated with energy efficiency measures implemented in a home using BEopt™ energy modeling software. The data then was used to determine present worth of the annual energy savings for the remainder life of the home considering the energy inflation and discount rates. This approach makes the process of estimating the value added of an energy efficiency measure easier for appraisers. The other benefit of this approach is providing the simple payback period for each energy efficiency measure to help homeowners decide which measure to choose.

The value-added numbers may be converted to dollar per square foot and used for small size homes in a hot-humid climate. However, for medium or large size homes and in other climate conditions, a separate energy modelling and cost analysis like the one performed in this study are needed to calculate the value-added due energy efficiency measures.

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