

The project is one of three single-family homes built by Fluid Construction between 2006 and 2008, each built to an increasingly more robust green building standard. This home is ENERGY STAR certified.



ENERGY STAR Home Monmouth County, NJ



“The homeowners of this ENERGY STAR certified residence are committed green consumers. They are committed to living within their means, having a low carbon footprint and leaving a healthy planet for their child. They consider their investment in a green home to be part of this effort. Overall the homeowners are satisfied with the home.”



Location of Project: Monmouth County, NJ

Overview

This ENERGY STAR home in Monmouth County, NJ was completed in May of 2008, occupied in July of 2009 and is currently home to two adults and a small child. It was built by Fluid Construction as the second in a series of three progressively more energy efficient homes in the area. The home was built on a previously developed site in a residential neighborhood.

Transportation

The ENERGY STAR home is within walking distance of the town's downtown area and there is a NJ Transit bus stop nearby. There are also train and ferry services to New York City within seven miles of the home. However, transportation considerations were not a major part of the project.

Water Consumption and Appliances

The ENERGY STAR home was outfitted with high-efficiency ENERGY STAR appliances and lighting that have reduced energy consumption when compared to a home without these improvements. With the exception of the refrigerator, all of the other major appliances in the home are ENERGY STAR qualified, which use 10-50% less energy than standard appliances. When built, 25 percent of the lighting in the home was also ENERGY STAR certified, which use 75% less energy and produce 75% less heat than conventional lighting systems, which in turn reducing cooling loads. The homeowners were very satisfied with the functionality and performance appliances though were dissatisfied with the light quality of the ENERGY STAR fixtures. They have replaced two of the fixtures for traditional lighting.

As for water efficiency, the home was built with dual-flush 1.6/0.8 gallons per flush toilets; the homeowners are very pleased with them.

As part of a two-year study, the Rutgers Center for Green Building (RCGB) found that ENERGY STAR home used 35% less electricity and 54% less natural gas per square foot per year than a "typical" single family home in the area built to the International Energy Conservation Code (IECC) 2006. Given that heating constitutes more than 50 percent of an average home's energy use in the Middle-Atlantic Region, the home's reduced natural gas consumption is noteworthy. The lower electricity consumption is also notable, but the majority of electricity is used for purposes

Project Team

General Contractor: *Fluid Construction*

Architect: *Parallel Architects*

Energy Consulting Firm: *MaGrann Associates*

that are not affected by building design and are subject exclusively to user habits, most notably, the use of electronics.

Envelope, Heating and Cooling

The ENERGY STAR home is outfitted with fiberglass batt insulation throughout the house with R values of 38 for the ceilings and 60 in the attic. The frame is composed primarily of 2"x4"s but also use 2"x6"s in some areas. It is equipped with two high-efficiency air-conditioning unit with a seasonal energy efficiency rating (SEER) of 14, which are about 10% more efficient than the federally mandated SEER 13 units, and a two-zone, fuel-fired forced air distribution furnace with a annual fuel utilization efficiency (AFUE) rating of 95%, well above the AFUE of 80% required by federal regulation. The homeowners rated the thermal comfort of the home a 3.5 out of 5 (with 5 being the highest) because the rooms of the house at the end of the duct line, furthest from the heating or air conditioning unit were not as well regulated as other parts of the house.

The home is also equipped with several ceiling fans which the homeowners use "all the time" when the weather isn't too warm and keep the windows open whenever possible.

Operations

The operation of the ENERGY STAR home requires minimal effort. The heating and cooling systems are controlled by a digital thermostat that is programmable to conform to the occupants' thermal preferences and can be adjusted remotely via the Internet. Overall, the homeowners were satisfied with the capacity to control the heating and cooling systems. The ability to adjust the humidity in the household was also

Process

Design

The ENERGY STAR home was the second progressively more green homes built by Fluid Construction in the same area. Prior to this, Fluid Construction worked on homes built to the standard





Ratings and Awards

ENERGY STAR Certified

code, but realized the potential benefits of building green.

Build

The general contractor was responsible for ensuring the home, as built, met the criteria to obtain ENERGY STAR certification.

Operate

As mentioned above, the ENERGY STAR homeowners have found the operation of the home's heating, cooling, and humidification systems to be very user friendly, though they found that the heating and cooling distribution throughout the house was not as even as they had expected.

The homeowners contracted to have their basement finished. As part of that project, they added another duct to their distribution system in order to improve the humidity levels in the space to eliminate the mustiness and the need for a dehumidifier.

The tank-less water heater has also presented some inconvenience for the homeowners as they mentioned that they had to run the water for several minutes before it warms, though conceded that this is an issue in many single family homes.

Evaluate

As mentioned above, the ENERGY STAR home was one of three newly built homes in Monmouth County that was part of a two-year, post-occupancy evaluation conducted by the RCGB. The study included an analysis of monthly electric and natural gas bills as well as quarterly water bills. A full life-cycle costing (LCC) analysis was completed. The homeowners were also interviewed twice during the study in order to ascertain user habits and preferences as well as satisfaction levels.

Finance

A life-cycle cost (LCC) analysis was conducted on the ENERGY STAR home in order to evaluate whether the energy efficient features included in the design are worthwhile in an economic sense over from the home's construction to its demolition. Considerations of homeowner satisfaction, comfort, or environmental benefits are not taken into account. Again,

the REM/RATE model was used to project the home's annual end-use consumption and cost for electricity and natural gas and compared to an average, mid-Atlantic detached single family home built to the IECC 2006 standards.

The ENERGY STAR home, as designed, was expected to consume 15% less electricity and 33% less natural gas than an average IECC 2006 home and, as mentioned above, actually consumed 35% less electricity and 54% less natural gas. These increased efficiencies did come at an extra cost. As built, the total initial cost for the appliances, heating and cooling system, windows and insulation of the ENERGY STAR home was \$13.69/sqft as compared \$11.99/sqft for the average home, a difference of \$1.70/sqft.

A net present value (NPV) calculation was completed in order to determine the lifetime value of the improved efficiency of the ENERGY STAR home. The primary analysis assumed a 30-year building lifespan, a discount rate of 7.0% and used a projection for energy prices based on the linear regression equation of historical energy prices from 1992 to present. The natural gas projected increase is 2.2% and 4.3% for electricity. The results found that the NPV of the ENERGY STAR home was \$6.57/sqft greater than that of the average mid-Atlantic home. In other words, if the conditions of this analysis hold over the life of the ENERGY STAR home, the initial investment in energy efficiency improvements will result in a substantial net positive investment when compared with a standard home due to the marginal efficiency gains of the technology upgrades.

In order to mitigate some of the uncertainty of predicting the future, RCGB also conducted a sensitivity analysis varying the building lifespan, the discount rate, and the energy price escalation rate. The energy price escalation rates are derived from the Department of Energy's Short Term Energy Outlook. Three different energy price scenarios have been calculated. The low projection assumes a 0.0% rate increase in price for both natural gas and electricity prices. The medium projection is based on the historical increase in energy prices from 1992-2010. The medium growth natural gas price rate is 2.2% and 1.3% for electricity. The high projection is based on the percentage change over between 2000 and 2010. The high growth natural gas price rate is 4.3% and 3.3% for electricity.



The results are as follows:

Building Lifespan	Energy Price Escalation Rate	Discount Rate		
		5.26%	7.00%	12.00%
15 Years	Low	\$3.84	\$3.24	\$2.00
	Medium	\$4.60	\$3.90	\$2.43
	High	\$5.66	\$4.80	\$4.55
30 Years	Low	\$6.40	\$5.03	\$2.67
	Medium	\$8.44	\$6.57	\$3.42
	High	\$11.77	\$9.01	\$5.12
50 Years	Low	\$7.78	\$5.77	\$2.81
	Medium	\$11.24	\$8.05	\$3.68
	High	\$18.06	\$12.31	\$5.12

Performance

The RCGB has collected utility bills from the homeowner between November 2009 and October 2010 to assess the building performance. Based on an analysis of those bills, it was found that the ENERGY STAR home is performing better than expected in terms of both natural gas and electricity use. Based on a building model created using REM/RATE software, the ENERGY STAR home was expected to use 0.28 therms/sqft/year but in actuality used 0.19 therms/sqft/year—about 32% lower than expected. In terms of electricity, the home was expected to use 2.9 kWh/sqft/year but actually used 2.2 kWh/sqft/year—about 24% lower than anticipated. (Note: These numbers differ from those cited above as these are comparing the actual natural gas and electricity consumption of the ENERGY STAR home with the expected consumption of the home as modeled in REM/RATE. In the above example the actual use was being compared to a modeled home built to the IECC 2006 standards.) Again, more so than natural gas, which has a comparatively limited scope of use (cooking, water heating, and space heating, the last of these being by far the most significant), electricity is used for many purposes that

are exclusively linked to user habits and cannot be mitigated or improved by building design. Most notable is the intensity and frequency of electronic use. Further, extraordinary circumstances that demand large amounts of electricity such as home improvements or the addition of new appliances cannot be fully anticipated in the REM/RATE models.

Lessons and Trade-offs

Overall, the homeowners are very satisfied with their home though they have had ongoing improvements to the house and property. The LCC analysis shows that the energy efficient upgrades to the house will be economically beneficial in the long run. The house is performing beyond expectations and well above the levels expected of a home built to code standards, though there seems to be room for improvement for the air distribution system in the house.

List of Green Strategies

Design

- Brownfield and Infill Development
- Low Flow Fixtures
- Insulation
- High Efficiency Windows
- High Efficiency HVAC Equipment
- ENERGY STAR® Appliances and Lighting
- On-Demand Hot Water Heater
- Zoning

Operate

- Programmable Thermostat

Evaluate

- Building Performance Evaluation

