

1600 Guaranteed Performance Affordable Homes

Jonathan Coulter¹

ABSTRACT

Launched in 2001, the mission of this guaranteed performance housing program is to provide an achievable process to meet EPA ENERGY STAR[®] for New Homes status through targeted training and technical support that leads to improved health, safety, durability and energy efficiency of affordable homes in North Carolina. The goal of this program is to build homes that are not only affordable to buy, but affordable to live in for low-income families. These ENERGY STAR[®] “plus” homes, being certified at a rate of more than one per day, can save homeowners 20% on heating and cooling energy as compared to standard-built homes. The energy saved in the state of North Carolina by the 1600 homes built to date is 47,175 kilowatt hours, which is equivalent to *not* driving your car for 34,913 days.

The program is based on identifying crucial elements in the design and construction of homes, as well as developing mutually beneficial creative ways to improve current field installation processes. To achieve its mission, the full package of program services includes:

- Plan review
- Standards and specification writing
- Contractor and sub-contractor training
- On-site quality assurance
- Performance testing
- Building monitoring
- Building diagnostics

Working with builders, developers, utilities and other organizations seeking to improve the quality of the buildings they build, this program seeks to bridge the gap between what research states can be done and what really happens at the building site. The building program offers increased sales, quality, comfort, performance, affordability and satisfaction. It also results in decreased callbacks, liability and living costs, and less negative environmental impact.

INTRODUCTION

Launched in 2001, this guaranteed performance housing program provides the training and technical support that leads to improved health, safety, comfort, durability, and energy efficiency of affordable homes. Non-profits developing low and moderate-income housing within North Carolina are eligible to start building with this program thanks in part to statewide funding organizations helping to defray the incremental costs often associated with building high performance homes. Having worked with partners

¹ Jonathan Coulter is a Building Science Associate with Advanced Energy, Raleigh, NC.

nationwide to develop home guaranteed programs, this program now offers its own utility and comfort guarantee to homeowners of more modest means. In partnership with the statewide funding organizations, more than 45 non-profit builders in North Carolina, including community development corporations, Habitat for Humanity affiliates, local governments, public housing authorities and other non-profits plan to extend this guarantee to their homeowners.

With the heating and cooling use and comfort guarantee in hand, the original homeowner is assured that for a period of two years the energy used to heat and cool the home will not exceed a specified amount, and the temperature in the center of any conditioned room will not vary more than three degrees from the thermostat setting. If those conditions aren't met, the energy cost overrun will be paid directly to the homeowner and diagnostic work (done free of charge) may be incorporated to identify problems with the original equipment or construction.

To date, 1600 homes in this program have been built. Ongoing support throughout the design, construction and marketing processes is provided to new and existing developers. All homes in this program carry a house plan-specific heating and cooling energy guarantee. These heating and cooling guarantees generally average from \$16 to \$40 per month, with most falling between \$25 and \$30 for a 1300 square foot home. If a home exceeds its guaranteed usage at the end of the year, the difference in cost will be paid to the homeowner. In seven years, the program has paid out just over \$3,500 with checks as low as \$0.50 and as high as \$250. The majority of the high payouts, however, were due to equipment failure such as leaking refrigerant or improper use of the HVAC system's thermostat. The comfort guarantee is also in place to ensure that these homes are not only financially affordable to purchase and live in, but are also comfortable.

The success of this program is rooted in the belief that any building must be viewed as a system. Change any one part and the whole is changed — either improving the system or making it worse. Each change will have a potential affect on three different areas: health of the occupants, comfort in the indoor environment, and efficient operation and maintenance. Each change must be evaluated on how it will affect moisture migration, heat flow, air flow, and the environment both inside and outdoors. Everyone who is involved in the delivery of a house to market, from the designer and the builder to the occupant and service technician, has an impact on occupant health, safety, and comfort — as well as building durability and energy use.

DISCUSSION

Program Standards By treating the building as a system, this initiative helps educate and train building professionals on ways to improve the durability, energy efficiency, and environmental impacts of a house using standard building materials while focusing on the health, comfort, and safety of the occupants. This entails focusing on seven key practices, both during systems design and during the actual construction:

- Making the building shell airtight

- Emphasis on combustion safety
- Providing controlled ventilation to bring in outside air
- Optimizing the insulation value of the building shell
- Optimizing the performance of the heating and cooling systems
- Balancing the air pressure throughout the house to prevent undesirable infiltration
- Managing the accumulation and infiltration of moisture

To achieve repeated success in addressing these focused areas, the program relies on a process to ensure that builders and subcontractors are adhering to quality standards that are far more rigorous than today's typical construction standards. This six-step process for achieving high-performance homes is described below.

1. A plan review using computer modeling software identifies changes that need to be made to the project to meet EPA ENERGY STAR[®] for New Homes program requirements of air tightness, insulation and windows, HVAC sizing, lights and appliances as well as additional requirements for combustion safety, ventilation, and pressure balancing. When the house plan meets the program guidelines, the heating and cooling guarantee can be calculated.
2. Classroom and field training is provided to ensure that both new and existing contractors and key subcontractors for insulation and HVAC understand the program standards.
3. Targeted field visits will occur at the building sites during key points of construction to ensure standards have been met before advancing to the next building phase. At these stages, potential problems that may undermine standards can be identified and preemptively corrected.
4. When construction of the house is completed, multiple performance tests are conducted to verify that each house meets the program standards. These include: house airtightness, duct system tightness, exhaust fan air flows, outside air intake air flows, and pressure balancing of the house.
5. Once the performance standards are field verified, the house is formally certified to meeting the standards of both the guaranteed performance program and ENERGY STAR[®] program.
6. At this stage, the heating and cooling energy and comfort guarantees are issued for two years. If, in that two year timeframe, the house uses more than the guaranteed amount of energy, the difference will be paid to the homeowner and field testing may be included to determine root causes for differences.

Homeowner and Societal Benefits Research performed by program administrators found that this program is proven to save 15% more in total energy use costs than standard code-built homes. The study compared 12 months of energy usage data in central North Carolina homes that were less than five years old. While a typical 1,700-square-foot house used approximately 17,056 kWh of energy with total costs of \$1,431 yearly, the homes built to the guaranteed performance standards used approximately 14,579 kWh of energy with total costs of \$1,223, a yearly savings of more

than \$200. This documentation is important, because home energy savings are often based on computer modeling rather than verified data.

Even more important than the lower average energy use per home, the guarantee performance homes sampled in this survey showed a smaller range of energy use and cost than the sample of code-built homes. This demonstrates a crucial step in making the day to day operation of an affordable home as viable as the purchase price.

These data are a direct result of implementing an improved systems approach to home-building, which—when started at the beginning—allows for a more efficient process that will reduce mistakes (as well as warranty and liability claims), improve communication among sub-contractors, and benefit builders by providing a competitive edge that makes energy-efficient affordable housing cost-efficient.

Utilizing this comprehensive process in the design and construction of affordable housing in North Carolina has provided multiple benefits to the homeowners and community. For the homeowner, it offers a heating and cooling guarantee with the potential that families will save up to half on the heating and cooling portion of their bills as compared to standard built homes; ENERGY STAR certification makes the homes eligible for reduced utility rates; and whole-house comfort, long-term durability and affordability are enjoyed by the homeowners. For the community, people in the building trades are paid to increase their skills and knowledge with the potential for generating new business and more energy-efficient homes means less need for new power plants.

Barriers to providing high-performance homes to lower-income families have been varied, but the most significant one was monetary—although the homes incurred some added costs, there was no obvious incentive for developers and builders to get involved in this way, as these homes did not sell faster or at a premium. This obstacle has been overcome to a certain extent because statewide funding groups that tied extra funding to meeting these higher performance standards.

By institutionalizing these building standards, these 1600 guaranteed performance affordable homes performed at much higher levels than those that were code-built. For example, in benchmark North Carolina houses, duct tightness (expressed as an air flow rate percentage of per square foot of floor area at a pressure difference of 25 Pascals) ranged from 4 to 79 %, but in the guaranteed performance houses, the range was only 1.1 to 12.7 %; in the benchmark houses, dedicated supply only outside air ventilation was 1 %, while in the program houses it was 100 %; performance tested spot exhaust ventilation was 0 % in the benchmark houses and 100 % in the program houses.

CONCLUSIONS

By modifying the EPA ENERGY STAR[®] for New Homes program requirements and institutionalizing a new base platform for affordable housing, the goal is not to be the greenest or the healthiest. Long-term, the program needs to be cost-effective and achievable. This guaranteed performance program has resulted in a 15 % greater savings in total energy usage and costs compared to comparable code-built houses, and by mid-2008, approximately \$1 million in utility bill savings will have been realized by homeowners. This is truly possible when builders can see and understand how all the parts of the system fit together, understand the interactions and can anticipate the interconnections of the parts in the function of the whole finished house.