A Growing Market for High Performance Homes

Published in the July 2002 Issue of Homebuilder Magazine

In the long run, men hit only what they aim at. (Thoreau)
The simple explanation follows the complex solution. (Murphy's Laws)

Ask ten people what "high performance car" means and they'll probably agree it's a fast car that handles well at high speeds. When you put the pedal to the metal, you feel the force. It's probably a gas-guzzler. And it might need a lot of maintenance.

What about "high performance home?" While you may not have heard the phrase yet, it's already being used. But the phrase's meaning doesn't tightly parallel that of the high performance car.

This article describes E-Star Colorado's initial statement of what "high performance home" means. We've run it by some industry leaders. Though it will evolve further with time, this is a reasonable starting point.

Background

When engineer Joe Lstiburek used the phrase "high performance home" during E-Star seminars last winter, he was talking about homes meeting the goals and criteria of the DOE-funded Building America program. Ren Andersen (National Renewable Energy Laboratory) says the key Building America performance objective is a 30% to 50% reduction in energy consumption--compared to the same home built to the 1995 CABO Model Energy Code.

Building scientist Mark LaLiberte used the phrase "high performance home" extensively during a May 9 seminar at the HBA, again co-sponsored by E-Star and Building America. (He'll be back in October for more seminars.) To Mark, high performance home means a house that is healthy, comfortable, affordable, energy efficient, environmentally responsible, and durable.

The key publication from the Energy and Environmental Building Association (EEBA) is its excellent *Builder's Guide* series of handbooks (Author: Joe Lstiburek). The book's cover provides a description nearly identical to the one LaLiberte uses.

Working Definition

Building on the descriptions above, here's E-Star's working definition: A high-performance home relies on systems-engineered design, quality-controlled construction and performance testing to assure that the home is healthy, comfortable, affordable, energy efficient, durable, and environmentally responsible. The energy efficiency criterion is a 40% energy savings compared to a home built to the 1995 Model Energy Code, or an 88 on the 100-point E-Star scale.

Such a home will come with a higher price tag. But it shouldn't cost more to own.

The twelve steps to higher performance are as follows:

1. ***Systems integrated design.*** During the design stages, the typical home must be reviewed and re-engineered on paper to meet the listed performance goals.

Typically, designs are modified to integrate mechanical system requirements with structural and architectural needs. This is the time to think "house as a system."

2. ***Modeling, analysis and equipment sizing.*** While the home is still just on paper, it must be analyzed to make sure that it will meet the high performance objectives.
3. ***Higher insulation levels, properly installed***. To achieve a 40% savings, higher than normal levels of insulation are essential; however, since house tightness and higher HVAC equipment efficiency are other means to achieve the savings target, the R-values in Table 1 are recommendations, not requirements. The recommendations vary moderately between mountains and plains climates. Just as important as R-value is proper installation of all insulation products. All cantilevers and floors above garages must be completely filled with insulation. Blown-in or sprayed insulation systems are recommended.
4. ***Solar-smart windows***. To improve comfort, reduce equipment sizes and save energy, low-e windows are required. For climates with fewer than 7000 heating degree-days, a home's windows should have a U-value of 0.35 or lower, with a Solar Heat Gain Coefficient of 0.40 or less. For the mountains, a U-value of 0.32 is required; SHGCs higher than 0.40 are encouraged since solar heat gains reduce the higher heating loads in mountain climates.
5. ***Tight construction***. Air leakage testing with a blower door should indicate no more than 0.22 natural air changes per hour of leakage (roughly equivalent to 0.25 cfm/ft2 of envelope surface area). This is just over 50% tighter than the average new Colorado home being built today.
6. ***Bulk water management system***. As described in EEBA's new *Water Management Guide*, "the fundamental principle of water management is to shed water by layering materials in such a way that water is directed downwards and outwards of the building or away from the building." To provide durability and reduce the potential for mold, a drainage plane covering walls is required for building durability; the drainage plane incorporates appropriate flashings around rough openings and at component intersections. The foundation must include a positive slope to facilitate surface drainage, a capillary break over the footing to prevent moisture movement up into the foundation wall, plus perimeter footing drains that provide positive drainage to either daylight or an accessible sump.
7. ***Water vapor management***. To reduce vapor transport by air movement from the interior into wall and ceiling assemblies, an interior air barrier is required; secondary air barriers that limit wind washing from the exterior are optional. As part of the air barrier system, a durable air barrier must be installed against the framing that will be adjacent to tubs, showers, fireplaces and entertainment centers, plus in ceilings above dropped soffits and within floor systems interior to rim joists. In the mountain zone, a vapor retarder is also required to reduce vapor movement across the wall assembly. In all locations, dirt floors in crawl spaces need a continuous (sealed) impermeable ground cover that serves as both an air and vapor barrier.
8. ***Controlled ventilation***. Mechanical ventilation must be provided. It should be sized to supply 10 cfm per bedroom plus an additional 0.01 cfm per square foot of conditioned space. If the ventilation system fails, there must be a positive

indicator that alerts homeowners (e.g., red light at a panel). Intermittent ventilation is essential for baths (50 cfm) and kitchens (100 cfm).

9. ***Safe and efficient appliances***. All combustion appliances must have the by-products of combustion isolated by either power venting, direct venting, or sealed combustion. Furnaces should have minimum 90% AFUE ratings. The water heater's Energy Factor should be either above EF-0.60, or should have extra tank and pipe insulation added to achieve at least this level of performance. Other supplied appliances should meet the EPA's Energy Star criteria.
10. ***Properly sized HVAC equipment with designed and sealed ductwork***. HVAC equipment must be sized to be no larger than ACCA Manual J calculations would indicate; as that calculation system is generous, no upsizing fudge factor for temperature setback is needed. Ducts should be designed based on room-specific load calculations (ACCA Manual D). Ducts must be sealed with a durable sealant product--a water-based mastic, butyl tape, or an aerosolized sealant system. Measured duct leakage must not exceed 10% of total system flow; this means building cavities can't be used for return-air ducts. Ducts against exterior walls or within attics require 100% of the component's insulation R-value between the ducts and the exterior.
11. ***Efficient use of building materials***. Use engineered lumber instead of dimensional lumber for floor joists and roof framing materials. Use advanced framing that incorporates at least 24-inch o.c. spacing, in both exterior and partition walls.
12. ***Performance testing***. In 1980, an official with the New York State Energy Research and Development Agency stated, "you get what you *in*spect, not what you *ex*pect." It's just as true today as it was 22 years ago. Minimum performance quality control includes testing for house tightness, duct tightness, total airflow through the HVAC equipment, and room-to-room house pressures (no more than 3 pascals of difference between rooms, with doors closed).

Table 1: Recommended insulation values

Building element	Less than 7000 HDD*	More than 7000 HDD*
Attics	R-38	R-45
Closed cathedral ceilings	R-30	R-38
Walls**	R-21	R-24
Basements	R-6	R-13
Crawl spaces	R-13	R-19
Edges of at-grade slabs	R-6	R-10
Insulated beneath heated slabs ***(req.)***	R-7	R-10

* HDD = heating degree-days, a measure of climate severity. Nearly all climates between Fort Collins and Trinidad and out to the Kansas border

fall below 7000 HDD. Foothill and mountain communities will have to bump up their R-values.
** In this table, R-value refers only to cavity and insulating sheathing; it excludes drywall, exterior finish, air films, etc.

Tough standard; any supply?

Presently, no one is consistently building to this definition of a high-performance home. Engle Homes, Centex/Fort Collins and McStain are three production builders who come relatively close to meeting this target. A few custom builders consistently build very efficient homes, though an item or two on this list may not yet be part of their standard construction process.

Educating consumers

Is the market demanding this type of home? Not yet. And it won't until it's re-educated. That's where LaLiberte comes in.

"Consumers have done a poor job of driving change," said LaLiberte. "They assume that all new homes will be healthy, comfortable, durable and energy efficient, so they focus on cosmetic details—what they can see vs. how the home works. They shop for cost per square foot. That's nuts. Does anyone shop for a car by the pound?"

"The assumption is that consumers can't grasp this concept of a high-performance home," said LaLiberte. "But consumers will recognize quality once it's explained to them."

At the end of the day, a fundamental principle consumers must also grasp is that a high performance home will cost more to buy, but not necessarily cost more to own. Utility savings will help offset most or all of the higher mortgage payment. But owners walk away with a better product and builders make more profit with fewer callbacks and less liability. What's not to like?

Steve Andrews consults with builders for E-Star Colorado and writes on energy issues (sbandrews@att.net). E-Star, at 303-297-7470 (www.e-star.com), is a non-profit home energy rating system that works with both new and existing homes statewide.