

Mixed, Humid Climate Region 50+% Energy Savings



Aldie Hunt

Aldie, VA

Developer/Owner:	High Ridge Custom Homes
Location:	Aldie, Virginia
Building Type:	Single Family Detached
Building Size:	5,000 - 6,500 sq ft
	4-5 bedrooms, 5-6 baths
Price:	from the low \$500s
Status:	1 completed, 10 available lots
SWA Contact:	Srikanth Puttagunta

High Ridge Custom Homes (HRCH) initially got involved with CARB due to Steven Winter Associates (SWA) being their LEED for Homes and Energy Star rater. Through that process, SWA realized that some additional savings from design optimization could be obtained by HRCH and suggested partnering with Building America.

The showcase prototype home built at 24035 Whitten Farm Court is HRCH's Savannah model. This is a 6,254 square foot home (including finished walk-out basement) with 4 bedrooms and 6 baths (5 fulls and 2 half baths) built on a 6.7 acre lot. CARB got involved with the project during initial framing, so not all design specifications were able to be optimized (i.e. 2x6 framing is still at 16" on center rather than 24" o.c.).

The homes have been designed to perform 50+% better than the Building America benchmark house (comparable to mid-1990s construction). To achieve the desired reduction in energy use, SWA recommended low-emissivity windows with a Solar Heat Gain Coefficient of 0.27; tightly sealed envelope achieving an annual natural infiltration rate of 0.09 ACH; ground-source heat pump (GSHP) with an AHRI rating of SEER 30/COP 5 for lower level zone; a GSHP with an rating of SEER 24/COP 4.5 for upper level zone; mastic sealing and buried ducts in the attic to achieve 86 cfm duct leakage to outside (1.13 cfm₂₅/100 ft²) for both zones combined; and ENERGY STAR fixtures and appliances.



"We are differentiating ourselves from competitors and as green building goes mainstream, homes not built green will become obsolete."

ENERGY EFFICIENT FEATURES

- Jeld-wen Premium Sitrine EX Series IG low-e 272 windows with argon (U-0.32, SHGC-0.27)
- Blown-in cellulose insulation (R-38) in attic
- Icnene open-cell spray foam insulation (R-20) in walls
- Icnene spray-foam insulated rim/band joists
- WaterFurnace Envision GSHP (30 EER/5 COP) for 1st floor and basement
- WaterFurnace Envision Split GSHP (24 EER/4.5 COP) for 2nd floor
- Compact fluorescent recessed light fixtures
- Energy Star® Viking and Whirlpool Appliances
- ASHRAE 62.2 compliant supply-only ventilation
- Mastic-sealed ductwork
- Hot water pipes insulated with insulation (R-4)
- Dehumidistat feature on programmable thermostat

GREEN BUILDING FEATURES

- Water-saver faucets and showerheads
- Occupancy sensors on exhaust fans
- Low-VOC paints and caulks
- Drought resistant landscaping
- 2,500 gal rainwater harvesting system

CERTIFICATIONS

- Exceeds Energy Star® Homes Standards with HERS Index = 42
- Participating in LEED® for Homes (Silver certification)

<http://www.highridgeva.com>



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The long-term goal of the Building America program is to develop cost-effective systems for homes that can produce as much energy as they use—a zero energy home. As teams increase the savings targets towards zero energy homes, maintaining cost neutrality is a key component. The added cost of higher efficiency technologies can typically be offset by reducing unnecessary waste in other systems or through utility bill savings. The annual mortgage payment is calculated based on a 30 year mortgage with a 7% fixed interest rate. For the showcase home, the cost neutrality is not currently positive.

Although some reported first-costs are high for this home (an estimated total of \$40,788), this incremental cost is expected to decrease significantly as GSHP and spray foam insulation gain a larger market penetration over the next five years as the building industry pays more attention to energy efficiency and homeowners push for “greener” technologies. The

economics improve even more if you include the \$2,000 federal tax credit that this house is eligible for. With the home for sale at \$1,555,000 or roughly \$248/ft², the efficiency improvements resulted in an increase of only \$6.52/ft². Looking at www.trulia.com, this home’s asking price is average (within 1% of the average) with respect to comparable homes.

Also, Virginia has inexpensive electricity compared to the national average (as of Sept 2008, the national average was \$0.1194/kWh). Using this national electric rate would have resulted in the neutral cash flow calculation to only be **(\$86)**. Though still not positive, this a much more compelling story. Though this specification package is not cost neutral currently, HRCH is still committed to maintaining their current efficiency levels and that is as good an indicator as any, in this market environment, that their efficiency package is a viable cost option.

Building Component	HRCH specifications	Regional standard practice	Estimated incremental cost over regional practice	
Foundation Walls	8" cast-in-place concrete	8" cast-in-place concrete	-	
	R-13 encapsulated FGB	R13 encapsulated FGB	-	
Rim/Band Joists	R-20 Icynene	R-13 fiberglass batts	included in wall insulation	
Exterior Walls	2x6, 16" OC	2x4, 16" OC	\$1,000	
Wall Insulation	R-20 Icynene	R-13 fiberglass batts	\$15,000	
Windows	Vinyl, double pane, low-e, argon (U = 0.32, SHGC = 0.27)	Vinyl, double pane, low-e (U-0.36)	\$500	
Ceiling Insulation	Blown-in cellulose insulation (R-38)	R-38 fiberglass batts	-	
Building Infiltration	1,990 cfm ₅₀ (0.094 ACH _{natural})		-	
Duct System	Right-sized system sealed with mastic, buried ducts in attic	Over-sized system sealed with alum. tape	included with GSHP	
Duct Leakage to outside	Negligible leakage to outside for basement/1 st floor unit.		-	
	86 cfm ₂₅ leakage to outside for 2 nd floor unit		-	
Space Conditioning	Basement/1 st floor - WaterFurnace Envision GSHP (30 EER / 5 COP)	SEER 13/ 7.8 HSPF air-source heat pump	\$20,000	
	2 nd floor - WaterFurnace Envision Split GSHP (24 EER / 4.5 COP) in insulated mechanical room in attic	SEER 13/ 7.8 HSPF air-source heat pump		
Thermostat	Programmable thermostats	Programmable thermostat	-	
Water Heating	State 80 gal tank electric water heater	Electric water heater	-	
Lighting	83% CFL fixtures	Standard incandescent lighting package	\$2,314	
Appliances	Energy Star Viking refrigerator	Energy Star refrigerator	-	
	Energy Star Viking dishwasher	Energy Star dishwasher	-	
	Energy Star Whirlpool Duet Clothes washer/dryer	Energy Star washer/dryer	\$1,974	
Whole-House Ventilation	Supply-only with fan control	-	included with GSHP	
			added first cost	\$40,788
			annual mortgage payment	(\$3,287)
			annual utility savings	\$2,214
			neutral cash flow	(\$1,073)



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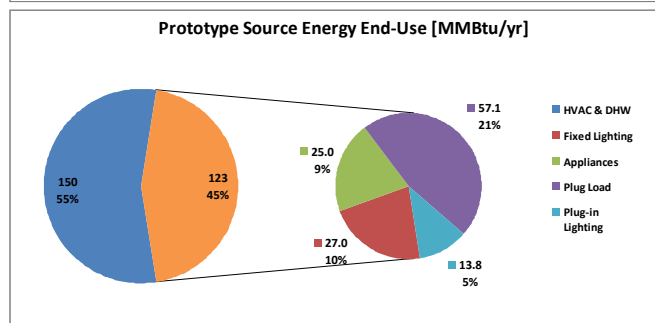
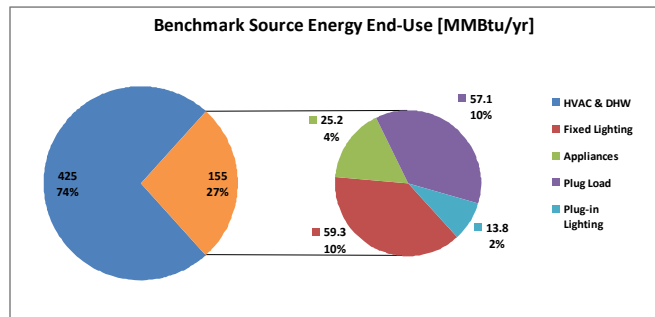
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The LEED for Homes and Energy Star programs incorporate many elements that are recommended by Building America. The list below identifies the major elements that were in line with Building America goals for this project.

LEED for Homes		
Credit	Category	Description
ID 2.1-2.3	Durability Planning & Management	durability checklist and inspection
LL 4.3	Management of Runoff from Roof	lot designed by professional to manage runoff from home on-site
WE 1.1	Rainwater Harvesting System	2,500 gal tank
EA 1.1-1.2	Performance of Energy Star for Homes	exceptional energy performance (42 HERS Index)
EA 3.3	Minimal Envelope Leakage	≤ 2.5 ACH ₅₀ (1.68 ACH ₅₀)
EA 4.3	Exceptional Windows	U-0.32/SHGC-0.19
EA 5.2	Greatly Reduced Distribution Losses	≤ 3.0 cfm ₂₅ / 100 sq. ft. (1.13 cfm ₂₅ / 100 sq. ft.)
EA 6.3	Very High Efficiency HVAC	SEER 30/5 COP GSHP
EA 7	Pipe Insulation	hot water pipes are insulated with R-4
EA 8	Advanced Lighting Package	60+% of fixtures are Energy star fixtures
EA 9.1-9.2	High-Efficiency Appliances	Energy Star refrigerator, dishwasher, and clothes washer
EQ 2.1	Basic Combustion Venting Measures	no unvented combustion appliances, direct-vent fireplace, CO monitors on each floor
EQ 3	Moisture Control	dehumidistat feature on programmable thermostat
EQ 4.1	Basic Outdoor Air Ventilation	supply-only whole-house ventilation with 8" outdoor air duct to lower HVAC system
EQ 5.2	Enhanced Local Exhaust	occupancy sensors
EQ 10	Garage Pollutant Protection	air sealed to isolate from living space

Energy Star Qualified Homes	
Category	Description
Thermal Bypass Checklist	minimize thermal bypasses in building envelope
National Performance Path Requirements	ductwork leakage ≤ 6 cfm to outdoors / 100 sq. ft. (1.13 cfm ₂₅ / 100 sq. ft.)
	include at least one Energy Star qualified product category: - heating or cooling equipment - windows - five or more Energy Star qualified light fixtures, appliances, ceiling fans equipped with lighting fixtures, and/or ventilation fans
	envelope leakage must be determined by a RESNET-certified rater all cooling equipment must be sized according to the latest editions of ACCA Manual J and S using the following operating conditions: - outdoor temperature is the 1.0% design temperature (ASHRAE Handbook of Fundamentals) - indoor temperature is 75°F for cooling - the infiltration rate shall be selected as "tight"
Energy Star windows	

As the Building America target moves to higher and higher savings goals, there is an ever growing need to address miscellaneous electric loads (MELs) and/or have homeowners change their operating behaviors. For a typical mid-1990s version of this home, MELs, major appliances, and lighting accounted for only 27% of the overall source energy usage. For a 50+% version of this home, these same loads now account for 45% of the source energy usage. Fixed lighting has been significantly reduced through the use of fluorescent light fixtures in the prototype. If this hadn't been completed, these loads would have accounted for roughly 51% of the overall energy usage.



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CARB wanted to get more insight from the builder, so the following is an interview with Tom Swigart, vice president – operations for HRCH.

Do you see HRCH continuing to implement the techniques and strategies that were pursued in the Aldie Hunt showcase home in future homes?

Many of the strategies we used have become more commonplace in the market in just a short time, making them more accessible and affordable at the same time. Products like Geothermal heat pumps, spray foam insulation and compact fluorescent lighting are very popular among the consumers that have visited our model home. There are not many builders today that have implemented these energy saving features into their everyday homes and it is something that sets us apart. We have found that the payback period of some energy efficient upgrades can be even better when implemented properly from an experienced contractor.

How difficult has it been to get sub-contractors (HVAC, plumbing, electrical, framing, etc.) to get on board with what HRCH is trying to do with green and energy-efficiency?

It was necessary for us to seek out qualified contractors for many of the “green” and energy efficient features rather than try to train a contractor on a new technology that we were not familiar with ourselves. It was refreshing that many of the contractors hired for this project were excited to work on a “green” home and implement many of the new techniques they have been learning in recent months. Our contractors are a great asset to us and their quality workmanship shows in every room of our showcase home. It is that quality that has impressed every visitor of the house whether it’s a consumer or tradesman.

Have you seen any signs of the market improving or worsening?

We have noticed some increased consumer traffic in recent weeks. The lower interest rates are a big help as well as reports that the housing market has reached the bottom of its decline. Of the ten or so visitors to our showcase home each week, I would say that at least six of them are serious buyers looking for the right fit. They don’t seem ready to make the decision to buy just yet but it’s only a matter of time before this pent up desire to buy a new home is released and

we start to see some real progress in sales.

Are there any interesting lessons about the process that you went through for this unique project that you can share with other builders?

One major lesson we learned through this process is that improving energy efficiencies and the entire green building process is not as expensive and overwhelming as many would want you to believe. We found that many of the techniques we implemented were more about planning and proper supervision, all of which was at no additional cost.

We still feel that some of the green building strategies such as wind power and solar power need to be further researched to find ways to reduce the initial costs to make them more appealing versus current electrical sources. The biggest challenge for builders looking to invest in green building techniques is knowing the right combination of strategies and techniques that will provide the best quality for the right price for the consumer. There is no question we need to find new ways to build homes to reduce our dependency on fossil fuels and electricity but there are too many options to achieve various results and the builders and consumers have become somewhat hesitant to fully embrace the green building movement. With all the possibilities and choices on how to “Go Green” we find that people are not sure what the best solution is right now and are willing to wait and see what someone else chooses rather than make the choice for themselves.

What is your take on the current housing market and the future of certification programs such as EPA’s Energy Star and USGBC’s LEED for Homes?

Through countless surveys of homeowners throughout recent years, quality and integrity are two of the most important aspects consumers look for in a builder. Programs like Energy Star and LEED for Homes gives the builders a guide to ensure quality and they give the consumers the confidence that the home is built to a higher standard. Third party inspections from these programs are also a major plus for the consumer as well. Unfortunate, it is easy for a builder to miss some critical quality issues such as proper insulating or draft stopping, but with the help of a thermal bypass checklist, these potential issues are reduced significantly.