



BUILDING AMERICA TOP INNOVATIONS 2013 PROFILE

INNOVATIONS CATEGORY:

2. House as a System Business Case
- 2.1 New Home with Whole House Package

TOP INNOVATOR:

BA-PIRC, IBACOS,
PHI, CARB, BSC,
Northern STAR, ARBI

Zero Energy-Ready Single-Family Homes

Since 2008, the U.S. Department of Energy's (DOE) Builders Challenge and Challenge Home programs have recognized hundreds of leading builders for their achievements in energy efficiency—resulting in over 14,000 energy-efficient homes and millions of dollars in energy savings.

Building homes that are zero energy ready is a goal of the U.S. Department of Energy's Building America program and one embodied in Building America's premier home certification program, the Challenge Home program.

A net zero energy home is one that produces as much energy as the home uses. Solar power from photovoltaic panels can provide the energy but before the panels go on, there is a lot the builder can do to reduce the amount of power the home will consume. Increasing insulation levels, air sealing the building envelope, and installing the most efficient HVAC, lighting, and appliances, when done with a whole-house approach that also takes into account building durability and moisture issues, will all help to reduce energy demand. Conduit, wiring, and plumbing for solar photovoltaic and water heating panels can be conveniently added while the home is under construction, resulting in a zero energy-ready home, ready for solar panels whenever the homeowner is ready to purchase them. With a super-efficient home, not only will the homeowner have lower utility bills, when they are ready to install solar, they'll need fewer panels to reach net zero, and fewer panels mean lower costs for purchase and installation.

Building America's research is aimed at the goal of constructing high-performance homes and many of the Building America research teams have worked directly with builders to construct zero energy or zero energy-ready homes. Here are just a few examples.

The Consortium for Advanced Residential Buildings, operated by Steven Winter Associates, worked with Preferred Builders, Inc., on a high-performance test home in Old Greenwich, CT. Technologies and strategies used in the "Performance House" were not cutting-edge, but simply "best practices practiced." Closed-cell spray foam insulated the unvented attic and the interior of the foundation wall and wrapped the underside and sides of the slab while 1.5 inches of rigid foam sheathing covered the outside of the walls, which were filled with R-21 of blown insulation. The HVAC consisted of a natural gas wall-mounted boiler, which provided heat for two hydro coils with variable speed fans. An ERV provides fresh air to the tightly sealed home, which blower door tested at 1.0 air changes per hour at 50 Pascals. The home achieved 30% source energy savings and a HERS score of 43 before adding the PV, providing the home owner with low energy bills of only \$910 a year in this cold climate.

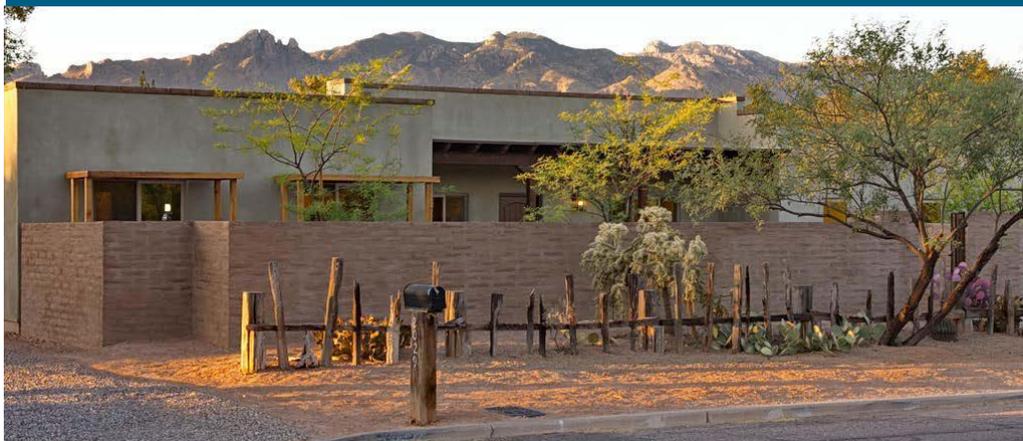


BUILDING AMERICA TOP INNOVATIONS

Recognizing Top Innovations in Building Science – The U.S. Department of Energy's Building America program was started in 1995 to provide research and development to the residential new construction and remodeling industry. As a national center for world-class research, Building America funds integrated research in market-ready technology solutions through collaborative partnerships between building and remodeling industry leaders, nationally recognized building scientists, and the national laboratories. Building America Top Innovation Awards recognize those projects that have had a profound or transforming impact on the new and retrofit housing industries on the road to high-performance homes.



(Top left) Building Science Corporation worked with Transformations, Inc., on a subdivision of super-insulated homes that earned HERS scores of 35 before adding solar PV.



The Partnership for Home Innovation, led by the Home Innovation Research Labs, worked with Nexus Energy Homes on net-zero energy house designs for a community of homes in the mid-Atlantic region using the latest technologies to enhance the indoor environment, conserve resources, and save energy and money. Nexus incorporates high-performance features including a geothermal heat pump, structural insulated panel (SIP) walls and roofs, efficient lighting and appliances, and solar photovoltaic systems in every home as standard features. Whole-house integrated electronics, controls, and monitoring devices provide the homeowner with measured functions, feedback, and performance data accessible by phone or computer. Houses come standard with sustainable features for indoor air quality, such as bamboo flooring, no-VOC adhesives, and a central vacuum. Homebuyers can choose architectural features, interior finishes, and fixtures such as flooring, cabinets, and lighting. Nexus spends considerable effort educating homeowners, appraisers, banks, and lenders on the value of high-performance homes. Nexus' homes qualified for DOE Challenge Home, ENERGY STAR, and the National Green Building Standard emerald level.

IBACOS prepared a report providing builders with guidance on developing partnerships with their subcontractors, material and product suppliers, and manufacturers, *Partnering for High Performance Homes*. IBACOS noted that high-performance homes require a high degree of coordination and significant interdependencies among various systems in order to perform properly, meet customer expectations, and minimize risks for the builder. IBACOS identified several critical success factors.

Building Science Corporation has worked with several builders on net zero energy homes. Recently they worked with Transformations, Inc. of Devens, Massachusetts, on eight production and custom homes that are all net zero energy ready homes. Even without PV, the homes would achieve HERS scores in the low to mid 30s thanks to double-stud walls filled with 12 inches of open-cell spray foam that yields an R-46 insulation value with exceptional air sealing. R-10 of rigid foam insulates the basement slab while R-20 of closed cell spray foam insulates the inside of the basement walls and R-36 of spray foam covers the rim joists. Minisplit heat pumps heat and cool the interiors, while PV panels on the roof help the homes achieve HERS scores as low as minus 37.

(Left) The ARBI team, led by Davis Energy Group, worked with La Mirada Homes on this SIP prototype home in Tucson that uses an air-to-water heat pump to heat water for radiant floor heat and chill water for fan coil and radiant floor cooling.

(Right) The BAPIRC team, led by Florida Solar Energy Center, worked with Tommy Williams Homes, who builds homes in a community with a competing builder. Adopting a zero energy-ready strategy as standard enabled them to turn a 40% market share in 2006 into an 84% market share in 2012, at a higher price per square foot. FSEC also helped Lifestyle Homes adopt a zero energy-ready strategy as standard, and the builder has more than tripled sales from 2009 to 2012.

REFERENCES

German, A., B. Dakin, C. Backman, E. Weitzel, and D. Springer. 2012. *S.E.E.D. Home Evaluation*, Davis Energy Group. http://apps1.eere.energy.gov/buildings/publications/pdfs/building_america/seed_home_eval.pdf

PHI. 2013. *Case Study: Nexus EnergyHomes*, Partnership for Home Innovation

Prahl, Duncan. 2013. *Strategy Guideline: Partnering for High Performance Homes*, IBACOS, Inc., http://apps1.eere.energy.gov/buildings/publications/pdfs/building_america/strategy_guide_partnering_high_perf_homes.pdf

Puttagunta, S, J. Grab, and J. Williamson. 2013. *The Performance House – A Cold Climate Challenge Home*, Consortium for Advanced Residential Buildings, http://apps1.eere.energy.gov/buildings/publications/pdfs/building_america/performance_house_cold_ch.pdf%20

Thomas-Rees, S., D. Beal, E. Martin, and K. Fonorow. 2013. *Approaches to 30% Energy Savings in the Hot-Humid Climate*, NREL/SR-5500-57823, NREL. www.nrel.gov/docs/fy13osti/57823.pdf

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The U.S. Department of Energy's Building America program is engineering the American home for energy performance, durability, quality, affordability, and comfort.