

Building a Zero Energy Mega House

by **Scott Lanzer** | Aug. 26, 2015

 Comfort  Cost Savings  Environment



We have been working on a video series about designing a state-of-the-art air conditioning system for a large, new construction home near Knoxville, TN. Along the way, we began calling this the “Mega House” due to its physical size and the scope of the project. Links to the videos are shown at the end of this article and illustrate the steps involved with one homeowner’s journey to integrate a superior HVAC system into what has become a superior, luxury home.

A few years ago, I had the pleasure of meeting an energy efficiency specialist named Jeff Christian. Jeff is a nationally recognized subject matter expert in energy efficiency and renewable energy. He is an accomplished Building Science Trainer of facility managers, building decision makers and building owners. He also works with private industry to develop and demonstrate profitable energy efficient technologies, practices and facilities, and he has written more than 170 technical papers, reports and journal articles.

When I first met Jeff, he was asked to help design and make an energy efficient large house. “How large?” I asked. Jeff responded that it would be roughly 9,000 sq. ft., and his first reaction was to suggest cutting the house by 2/3, and told the homeowner to read his book “How to build a zero energy house,” and call him in the morning. Jeff’s second thought was “what an intriguing challenge.”

The project was further impacted by the homeowner explaining that a lot of attention had been paid to capturing cosmic energy, but very little thus far on the pursuit of zero energy. This opportunity kept looking better when he realized that the town building code jurisdiction where this house is being constructed, had just adopted the IECC 2012.

Town hall meetings at that time were being held with code officials and local builders. The code officials explained that many areas around the country have already adapted this code. However, the builders in general were rather hesitant to be some of the first in Tennessee to build homes to these new standards. Jeff and I both thought this was a terrific learning and teaching opportunity to change an entire local building culture from energy wasting houses to verifiable energy efficient homes. This case study tells the story of the path taken to become the first house in the area to meet these dramatically more stringent energy efficiency requirements, and the key role of the HVAC selection process.

A Mega-Zero Energy House (Technically Speaking)

The final design of the mega house is 8,225 sq. ft., which includes the walkout conditioned terrace level. The main and upper floors completely above grade account for 5,513 sq. ft. The first exercise Jeff always performs, for his clients, is to show how the new or retrofit house they are planning can attain zero energy. He builds an energy model of the house and inputs reasonable-high energy efficiency features. In the case of the Mega-house: a high efficiency HVAC system with a high efficiency heat pump and smart zoning. He also recommend:

- All ducts be placed inside the conditioned space
- R-10 exterior insulated slab insulation (including the slab edge)
- R-4 interior insulated board insulation to all ceilings exposed to the exterior or attic
- R-5 exterior insulated sheathing to all walls
- 100% CFL lighting
- Passive house standard envelope air tightness of 0.6 ACH@50,
- 80 gallon heat pump water heater
- ERV system
- Rotate the house 45 degrees clockwise to maximize winter solar gain and minimize summer window heat gain.

These features resulted in total annual energy costs of \$3,318 based on 2013 utility rates. The HERS rating (100 is typical new house and 0 is a zero energy house) was estimated to be 41.

Construction began on August 1, 2013. The build out schedule calls for a nine-month construction period. The following informational videos offer intriguing closer look at the Mega House Construction Project:

