Zero Energy Home Project

Vantage Point

By: Team Vantage Point

Members: Nick Johnston, Kyle Ennis, Nick Timer, and Mike Toman

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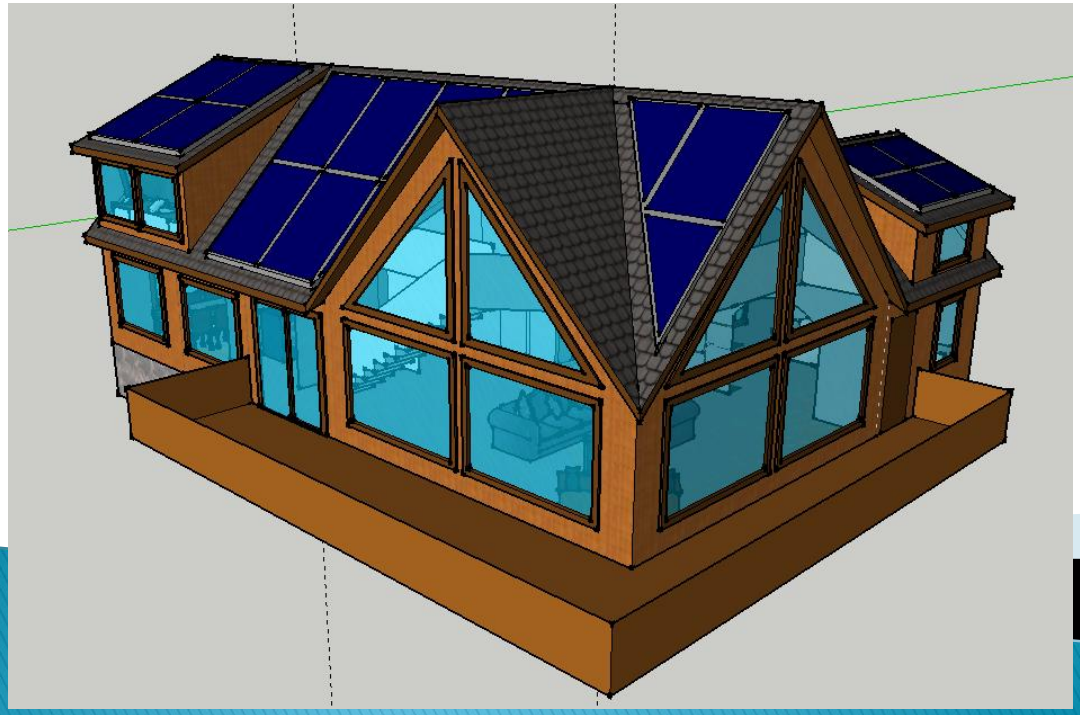


ZEH Overview

- Goals
  - The goals of this project was to make an appealing and affordable house that used net zero energy.
- Important Features
  - Windows – provides heat from the sun
  - Photovoltaic System – provides energy from the sun to put into the energy grid of the house
  - R60 Insulation – high R-value would reduce the loss of heat through the walls
  - Appealing Design

ZEH Specs

Location	Poconos, Pennsylvania
Floor Area	2,140 sq ft
Number of Floors	2
Number of Occupants	4
Number of Bedrooms	3
Type of Heating System	High-Efficiency Heat Pump
Size of Photovoltaic System	6.5 kW
Solar Water Heater	Yes
R-Value of Insulation	R60
VAHR	Yes
Predicted Annual Energy Use	Net Zero

Research

- Size is a big factor – the bigger the house, the more energy it takes to heat the building.
- Heating from the sun through the windows reduces the energy costs.
- PV panels and majority of the windows are on the south side because that's the direction from which the sun comes from in PA.
- ZEH homes are very expensive, but should relatively pay off after about 10 years through the decrease in energy bills.
- Tax incentives from the government help repay for the photovoltaic system and heat pump.
- Climate Design – houses should be built in order to take advantage of the climate and resources around it, i.e.) a house built in a windy area could take advantage of a windmill farm.

Key Decisions – Envelope

- Envelope
  - The R-value of the walls in our house is R60, which is one of the highest rated insulations in order to keep the heat in in the summer and out in the summer.
  - A high-efficiency heat pump was chosen as a heat source for our house because of the high rated R-value and the Air Changes per Hour (ACH) value of 0.1, which is considered to be a really tight construction tightness.
    - This choice was made instead of the ground source heat pump because it would save us money and the ground source heat pump wouldn't be needed to reduce energy costs because of the high R and ACH values.

Key Decisions – Appliances

- Energy Star – all of the appliances picked were labeled as energy star, so they are usually about 25% more efficient than a regular appliance.
  - Dishwasher – Bosch-she68e05uc
    - 1.57 gal/cycle
    - 167% more efficient
  - Refrigerator – Whirlpool model# G9RXXFMWB.
    - This is a refrigerator with a top-mounted freezer, which are proven to be more energy efficient than refrigerators with bottom or side mounted freezers.
    - Estimated energy use: 343kWh yearly
    - $37 estimated yearly operating cost

Key Decisions – Appliances II

- Television – Sony 40" BRAVIA EX500 Series HDTV
  - Power Consumption AC (watts): 180 W
  - Full HD 1080p resolution
  - Ambient sensor
  - USB input
  - Motionflow 120Hz Technology
  - 7 HD inputs
  - Starts at $820
- Washing Machine – Maytag MHWZ600TB
  - Front load
    - Generally, front-loaders were found to be far more energy efficient than even some Energy Star top-loaders
  - Capacity: 3.7 cubic ft.
  - Wash System: Rainfall Clean with Sensi-Care technology
  - 4 wash options, 5 spin speeds
  - CEE Tier III energy efficiency rating

Key Decisions – HVAC

- Lennox Signature XC21 Air Conditioner
  - 20.5 SEER energy efficiency rating
    - Could save up to hundreds of dollars per year vs. standard a/c units
  - Uses chlorine-free refrigerant
  - Listed in the GrenSpecs® directory of environmentally responsible products
- Lennox Elite XP16 Heat Pump
  - 17.0 SEER and 8.7 HSPF energy efficiency ratings
    - Could save up to hundreds of dollars per year vs. standard a/c units
  - Duel-fuel capability, can be combined with furnace for gas/electricity alternating
  - Uses chlorine-free refrigerant

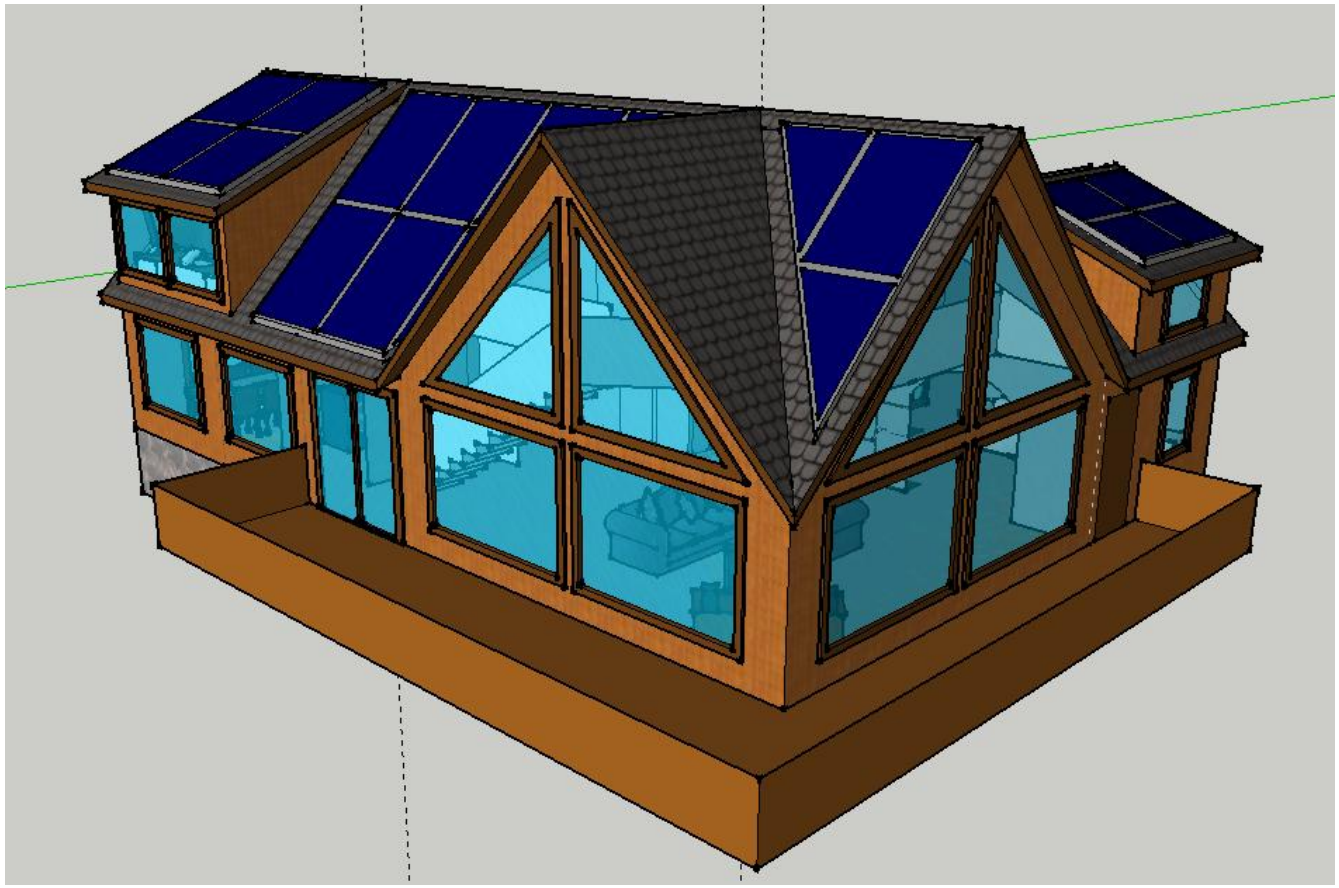
Key Decisions – Solar Technologies

- Solar Technologies
  - PV Panels
  - Solar Water Heater
  - Passive Solar Heating
  - (see next slide for details)

Key Decisions – Behavior

- High surface areas on the South face, and particularly on the story-and-a-half living room on the Southeast corner, allow for lots of passive solar heating in winter, but roof overhangs lower passive solar heating from higher solar angles in the summer.
  - Having some passive solar heating windows on the east side will also help heat the house on cool mornings as the sun rises.
- PV system
  - PV panels covering the south side of the main roof, and some small parts of the east roof harness the suns energy to keep the house self-sustaining
  - Solar water heating helps to save on heating energy and cost

SketchUp Model



Summary – Important Aspects

- Important Aspects
  - Windows
    - The large window area, especially on the south side, helps heat the house in the winter.
  - Photovoltaic System
    - The size of the PV system on our house is 6.5 kW, which is a big enough system to achieve our goal of a zero energy home. While this is very expensive, the PV system will pay for itself after the tax incentives and all the energy that the PV system provides throughout the years.

Summary – Challenges

- Challenges
  - Building the design in SketchUp and making it into a physical model

Personal Favorites

- Nick Johnston
  - My personal favorite was the living room. I liked this room because of the openness of the room with the open floor plan, open ceiling, and the balcony.
- Nick Timer
  - I feel that my personal favorite of our zero energy home is the overall design of the home. When we got assigned this project, I knew that I wanted the house to look like something that I would want to live in and not just some plain square house. I wanted it to reflect my dream house so our team looked at many different houses online and found one that we really liked. I like all of the different pitches in our roof with the unique vaulted living room accompanied with big windows. I think of the home as a dream house for the mountains and would definitely want to live there.

Personal Favorites II

- Kyle Ennis
  - My personal favorite would have to be the interior layout. We all agreed we wanted something more than just a box of PV panels, and we definitely accomplished that goal. Mike definitely brought all our imaginations to life with his SketchUp model. I really like the unique, appealing, and welcoming design of the 1.5-story living room; I think it really adds a touch of "dream house" to the whole thing. And the half-story 2nd floor definitely saves some heating/cooling volume, even with 2100 cu. ft. of floorspace.
- Mike Toman
  - I really liked the balcony overlooking the living room. It's a really cool, unique feature we had that I really tried to bring to life in SketchUp. I'm really glad how the whole thing turned out.

Conclusion

- Important Lessons
  - ZEH's are expensive at first, but should payoff in the long run – in about 10-15 years.
  - There are many tax incentives for different energy efficient products you can buy, which help pay for most of the product within the first year.
    - Products with tax incentives include: PV panels, wind turbines, and solar water heaters.
  - Small changes can go a long way.
    - For example – a low flow shower head you can install in your own home can reduce your water use by a half, which saves you money on your water and sewer bills.
  - Energy efficient construction helps reduce energy costs by a substantial amount.
    - For example – Building the walls with a really tight construction tightness and a high R-value especially in cold areas will help reduce heating costs.
  - Teamwork – everybody chipping in goes a long way into completing a big project.