Final Report

Introduction

A zero energy home (ZEH) is a residential building where the energy consumed by the homeowners is equal to the energy created on site. In these buildings, renewable energy technologies are used meet the energy needs of the homeowners. How ZEH is defined can shape the choices designers will make to reach their goal, and whether or not they succeed. Our goal for the ZEH is to utilize cost-effective, energy efficient strategies, and renewable resources that are located on or near the building to result in a balance between the energy use and energy gain.

Mission Statements

Production Description	A self-sustaining energy home
Benefit Proposition	The home is affordable, aesthetically pleasing and enjoyable to live in.
Key Business Goals	Product introduced in 4th quarter 2013. 25% Gross Margin and 10% Net Profit
Primary Market	Customers looking to save money and be energy efficient
Secondary Market	Environment friendly customers
Assumptions	Includes heating, cooling, hot water, all appliances
Stakeholders	Construction workers, buyers, realtors, retailers of appliances and materials, previous land owners

Customer Needs

“I want a home that is energy efficient.”

The zero energy home generates as much energy as it uses in a year.

“I want the home to be affordable.”

The zero energy home is low interest and is self-sustaining so it does not require the owner to pay annually for energy supply.

“I would like to have a room that I can spend time with my family.”

The zero energy home includes a living room with a seating area.

“I want to be able to cook and have family dinners.”

The zero energy home includes a kitchen with many necessary appliances and a dining area.

“I want the house to help my brother’s asthma and my frequent illnesses.”

The house has an air conditioning system that will filter the air to improve cleanliness and breathing conditions.

“I want the house to stay at a comfortable temperature.”

Concept Generation

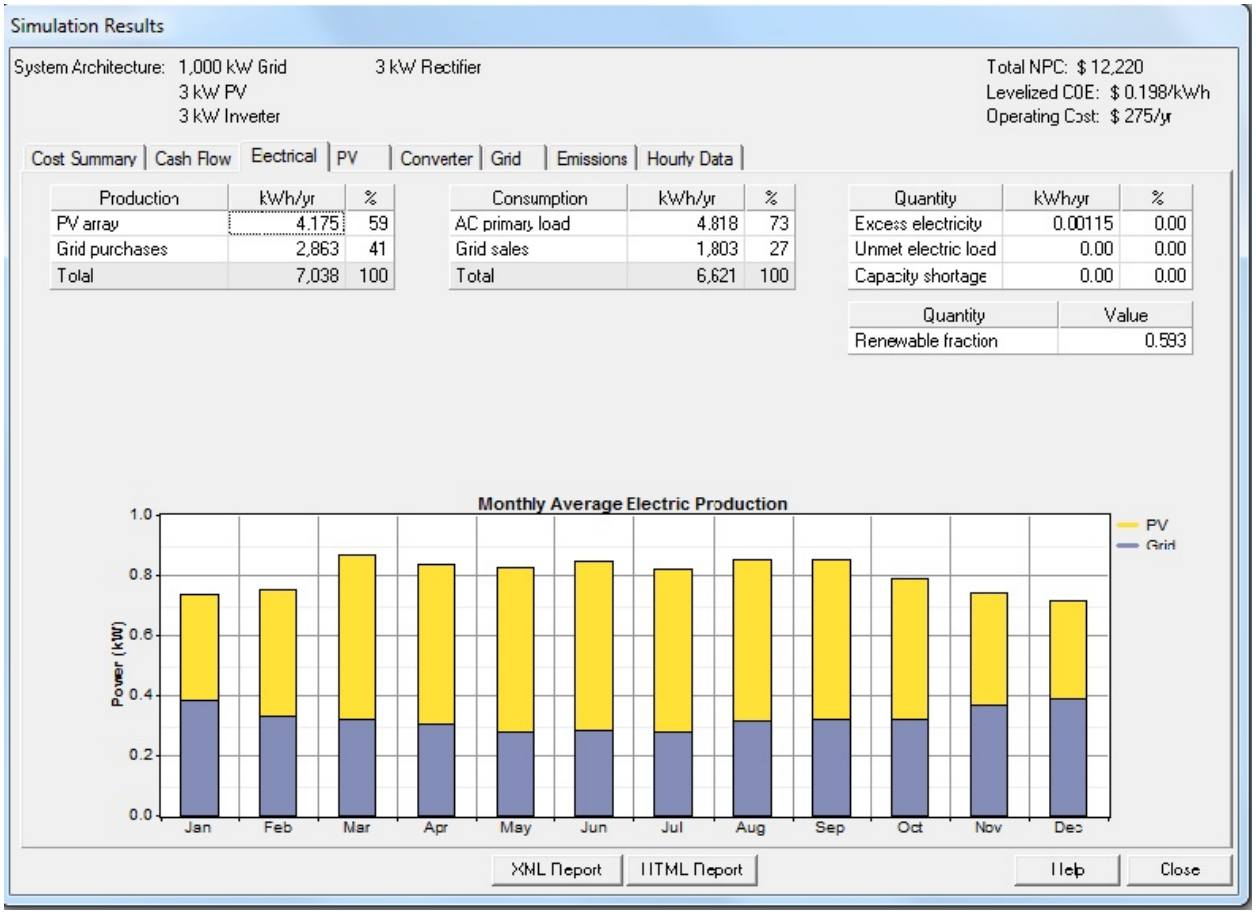
Solar panels, wind turbines, skylights, subterraneous, glass roof, insulated doors, fluorescent lighting, solar tubes, rooftop garden

Summary Table:

Location (city, state)	Harrisburg, Pennsylvania
House size (floor area in square feet)	1200 ft^2
Number of floors	1
Number of occupants	3
Number of bedrooms	3
Type of heating system (resistance, heat pump, etc.)	Forced Air
Size of photovoltaic system (kilowatts)	77 in x 39 ⅛ per panel 9 panels
Solar water heater (yes or no)	yes
R-value of wall insulation	13.73
R-value of ceiling insulation	2.0
Type of windows	Fixed
Ventilation air heat recovery (yes or no)	Yes
Total Cost ($)	
Any other pertinent info	Structure is underground

ZEH Calculations:

Household Item	kWh/year
Lights	790
Small Appliances	2056
Major Appliances	1625
Heating	148
Cooling	189
Total	4818

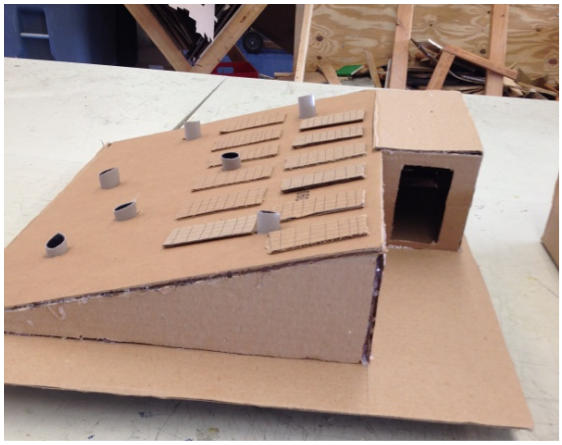


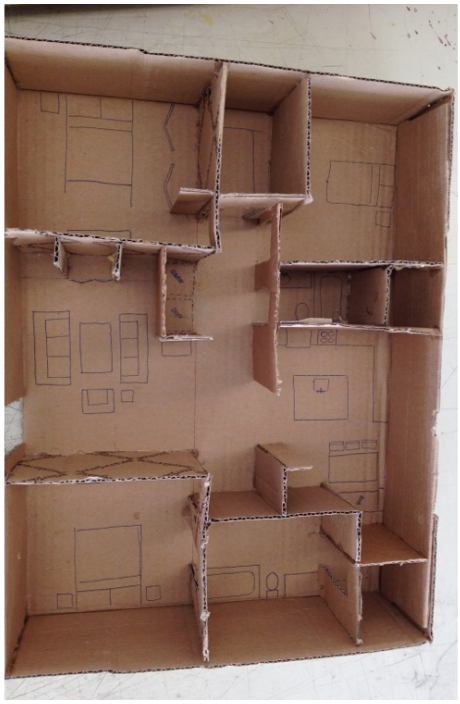
PV Array = 3 kW system

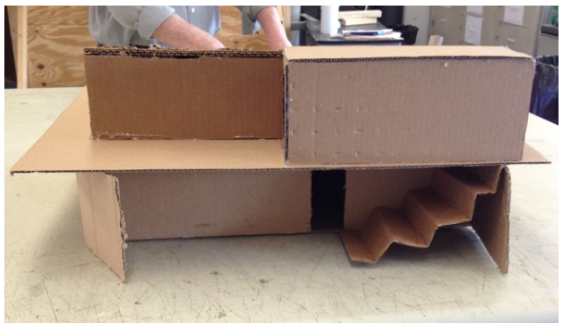
<u>PV System Details</u>

To have a 3kW system, 12 250 Watt solar panels will be placed on the roof. The roof is South facing and angled at 40 degrees for maximum energy output. The solar panels are CHSM 6610p models of Astronergy solar panels. They are efficient are relatively cheap. The total cost of the PV system will be $2920 for the solar panels and a total cost of $12,220.

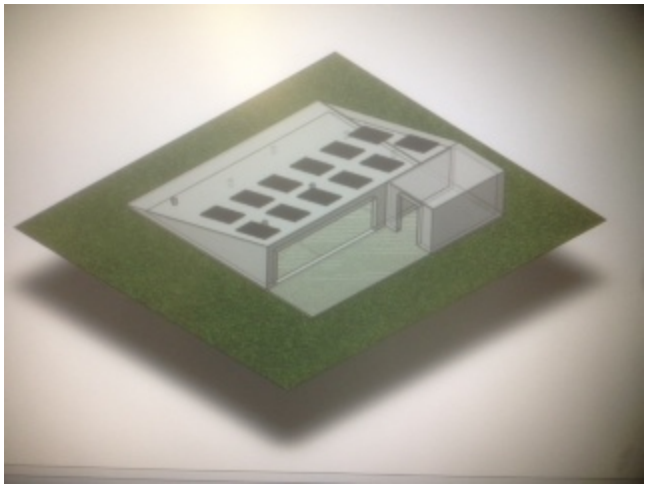
Physical Model Pictures:

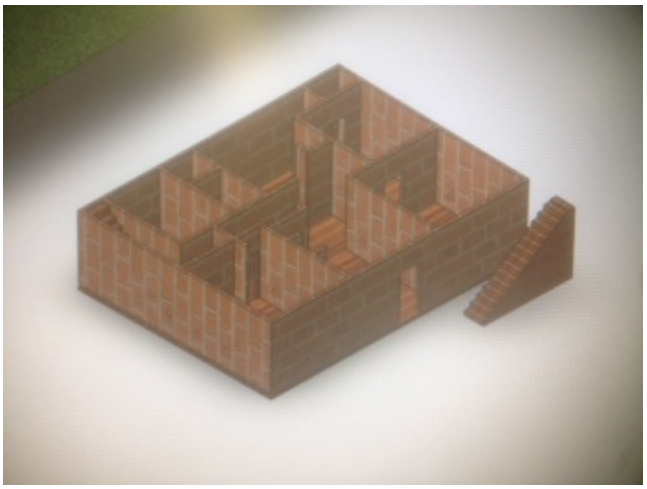


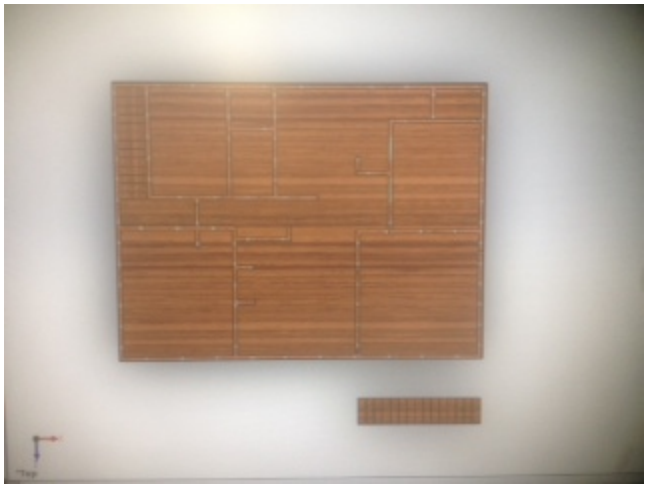


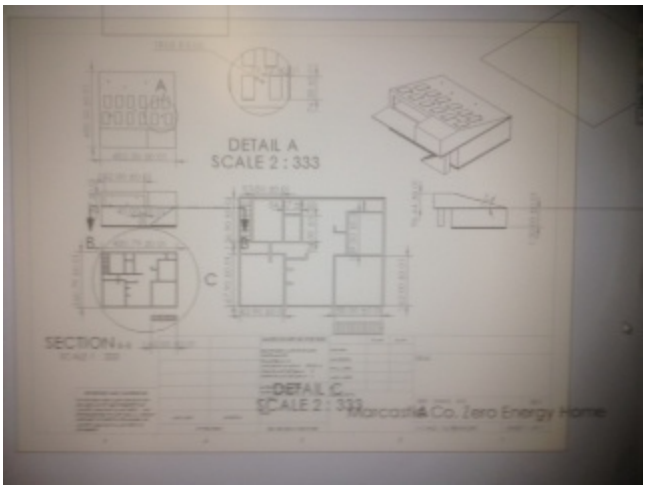


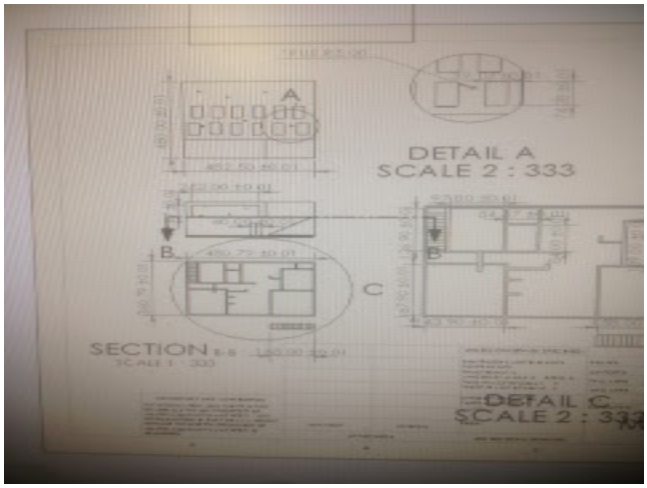
Solid Works Pictures

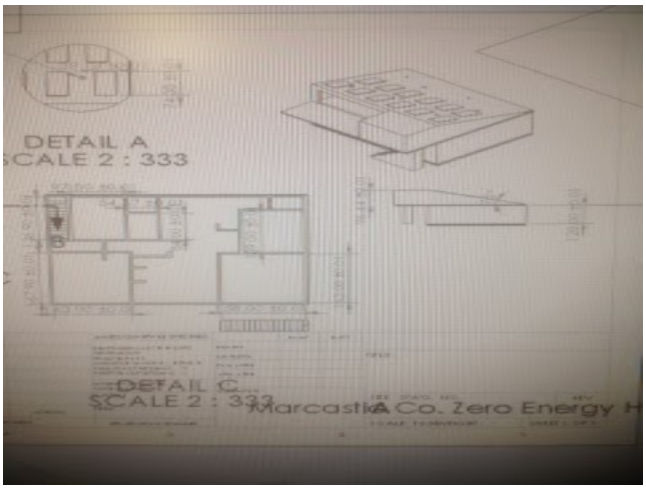












Conclusion

Through researching and preparing for this project we learned about zero energy homes and how to use the engineering design process. The zero energy home uses minimal energy by maximizing efficiency. All of the energy consumed is taken from the energy produced through the photovoltaic system. Solar tubes are used as an alternate, energy efficient lighting source. There are seven VELUX that will provide daylighting without the need for extra light bulbs. Solar tubes are both energy efficient and economical because, in the long run, they will save money on energy bills.

The energy calculations for the zero energy home took into account all small and major appliances, heating and cooling, and lighting. To minimize energy consumption, we opted to use high efficiency appliances such as Energy Star's washers, dryers, refrigerators, and dishwashers. These appliances use around 20% less energy and save thousands of gallons of water. We chose to make our home subterraneous because the insulations saves an average of 30% on heating and cooling bills. For our lighting, we chose solar tubes which capture sunlight and reflect the light into rooms of the house. We chose solar tubes over skylights because it eliminates the unwanted heat loss or gain associated with them. This reduces the electricity usage significantly. All of these high efficiency appliances and technologies help to reduce the amount of energy consumed by the homeowners. In this project, we learned how to properly use the engineering

design process. In the beginning, we identified customer needs (or the requirements of the process). We outlined what we needed to accomplish by the end of this project. Next we began concept generation. We did background research on other zero-energy buildings and used them as benchmarks. Two buildings we looked at were the Oberlin College Lewis Center and the Net Zero Energy House in Charlotte, VT. From these buildings, we obtained ideas such as proper wall insulation, light interior surfaces, high efficiency doors and appliances, and lighting controls. We also took their idea of using a photovoltaics system as a source of energy and an energy grid to store overflow of absorbed energy for later use. We also used consultation of experts as a source of concept generation. From one expert, we obtained the idea of making the house subterraneous. From another, we got the idea to use solar tubes as a source of lighting rather than skylights during the day. We used all of these ideas when deciding on our house's size, shape, materials, placement and orientation, and appliances used and setting our target specifications.

Work Cited

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http://dornob.com/underground-home-modern-house-with-a-green-roof/#axzz2h93O6dzf

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