Zero-Energy Home Report

Team Uno

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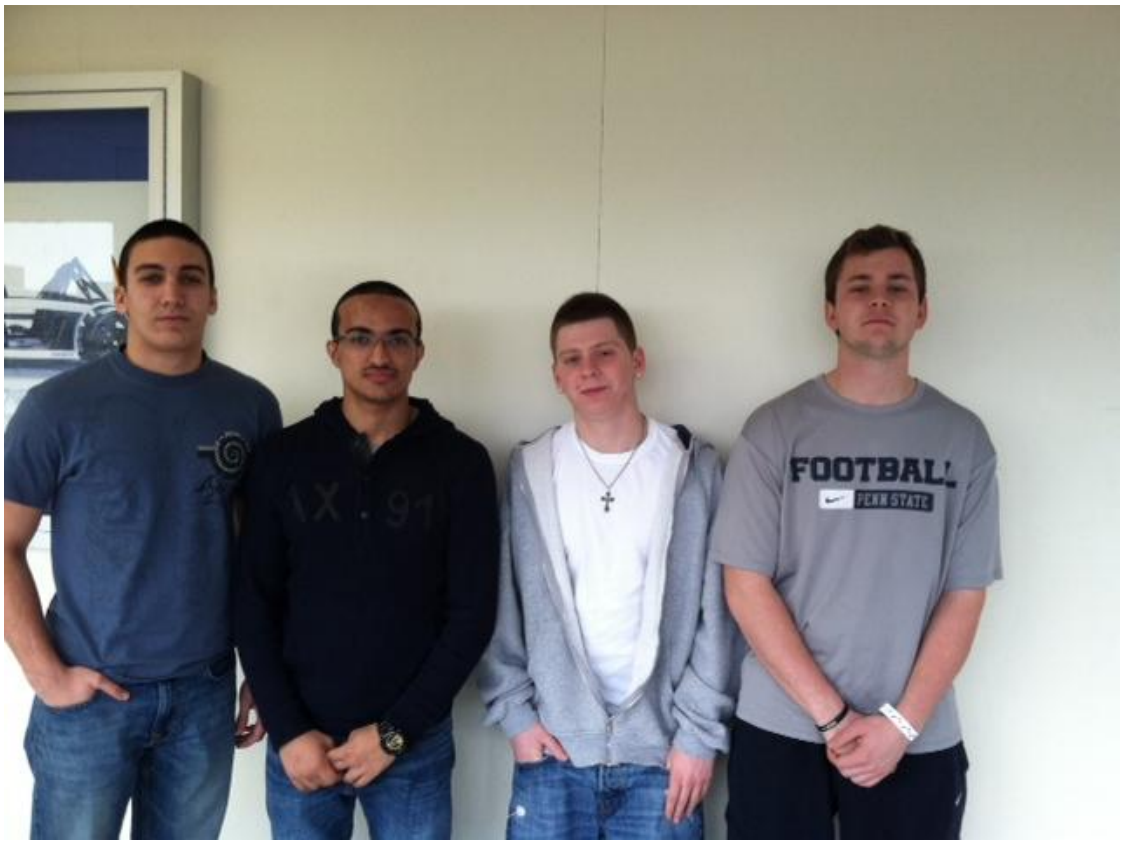


Mission

Today's society is faced with many problems and concerns. Amongst one of the biggest concerns is the fact that the average household consumes excess energy and power. One of the best solutions is building a Zero Energy Home. The purpose of this report is to see what the consumer's requirements are for making a zero-energy house in the northeast coast of the United States. The house has to have zero emission of greenhouse gases and provide the customer with all the qualities of a warm and cozy house with a convenient cost that is affordable.

Abstract (introduction)

The objective of the Zero Energy House project is to design a house with net zero energy Consumption for a family of four living in the northeast. Zero Energy houses are being integrated into the real estate industry because of their appeal to the environmentally conscious. They utilize alternative energy sources and minimize energy consumption. As a team we determined what the needs of potential customers are for such a house and used them to generate potential concepts. Then, we researched our potential concepts and determined which would suit our ideal house.

Concept Generation

1. We need to develop a sustainable home. That is, a home with zero net energy annually. The home must be located in the northeastern United States.
2. Energy in most homes today is not clean energy. The problem with applying clean energy to every home in the world is that it is very costly, and engineers have not made the process completely cost effective yet.
3. Different possibilities for clean, sustainable energy include:
    - Solar Energy
        - Solar panels
        - Thermo-tech Windows
        - Adjusting to Solar Angles
    - Geothermal Energy
        - Heating and Cooling
        - Heat Pump
        - Electricity generator
    - Wind Energy
        - Turbine(s)
    - Solar Thermal Energy

    - Solar Water Heater
    - Hot Water Baseboards
- Nuclear Energy
    - Nuclear Reactor
- Insulation(decreases energy loss)
    - Ceiling and Walls
- Electricity
- Plasma Energy
    - Plasma Lamp or Generator
- Natural Gas
    - Generator

Concept Selection

1. The Best solutions:
    - To heat and power home—Solar Energy. Our house is located in Pittsburgh, Pennsylvania. Pittsburgh receives 82% of the solar radiation that Miami, Florida receives (http://www.voxenergysolutions.com/solar.php). This makes our house a good candidate for Solar Energy.
    - To heat water and home—Solar Thermal Energy. This will heat the water used by the homeowners
2. In order to implement solar energy, our house would have solar panels on the roof that maximize the solar angles produced by the sun. Also, the use of Thermo-tech windows will collect and trap the heat that travels through the glass. Lastly, solar thermal energy will be implemented by using the sun's heat as a mean of heating water. This water will be used for conventional purposes and also for running through hot water baseboards that will contribute to the heating of the home.

Background Information (external research):

On Pittsburgh, PA (Zero Energy Home)

- In spring 2010, the City began a feasibility study to assess the potential for a solar farm in Glen Hazel. The 15-acre piece of property is unable to be developed, due to mine

subsidence. The proposed farm could produce enough electricity to power a few thousand homes.

- Pittsburgh is one of only 25 U.S. cities to be named a Solar America City through Department of Energy. Through this program, the City is working to accelerate the adoption of solar energy technologies.
  Solar works in western Pennsylvania! We receive 82% (NASA) of the same solar radiation that Miami, FL receives.

Comparing Zero-Energy Home

1-

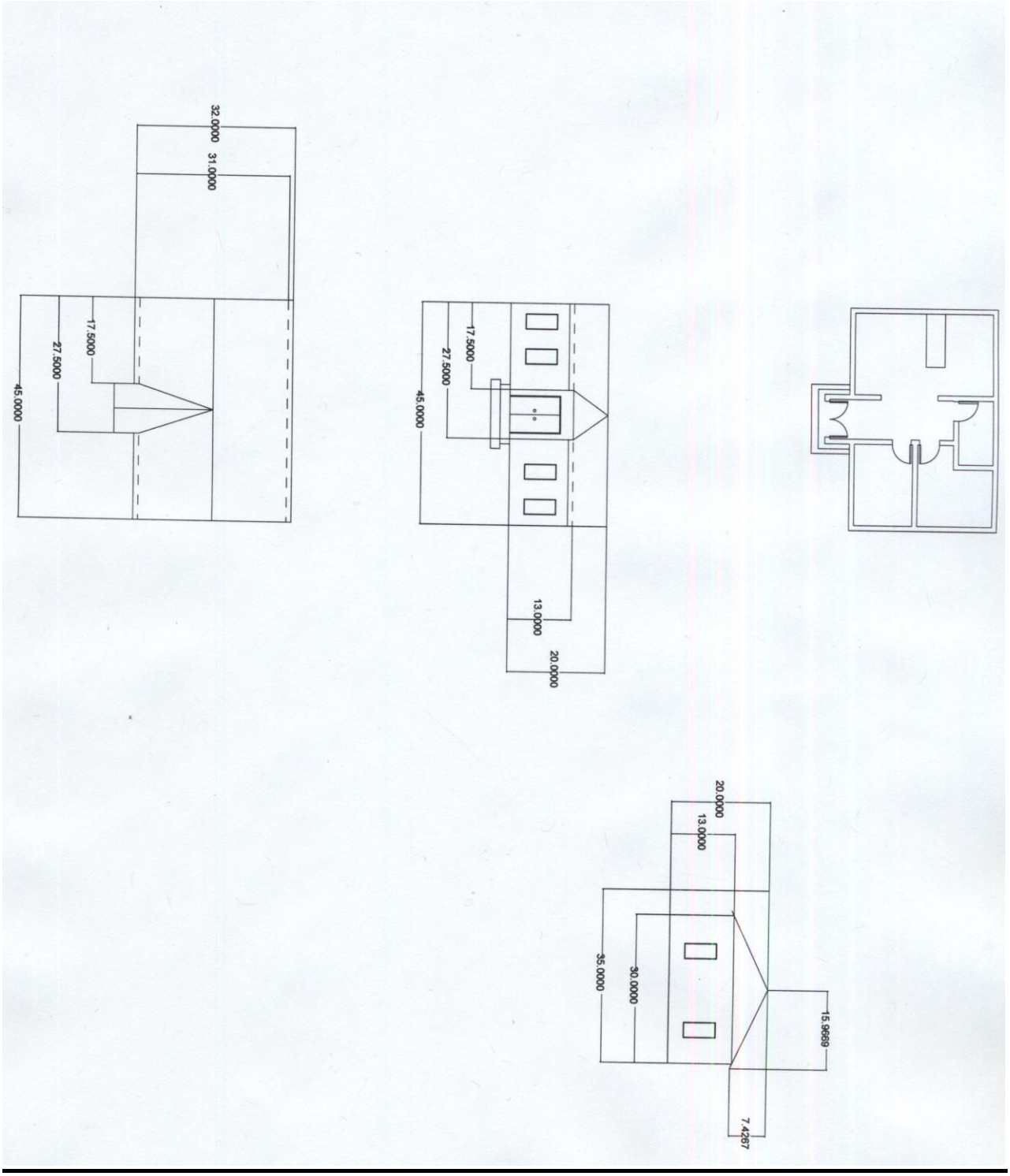
Location (city, state)	Pittsburgh, PA
House size (floor area in square feet)	1490
Number of floors	1
Number of occupants	3
Number of bedrooms	2
Type of heating system (forced air, hydronic, radiant floor, heat pump, etc.)	Radiant floor and hydronic
Main heating fuel (electricity, natural gas, wood, oil, etc.)	Natural gas and solar panels

Size of photovoltaic system (kilowatts)	16
Solar water heater (yes or no)	Yes
R-value of wall insulation	R 30
R-value of ceiling insulation	R 25
Ventilation air heat recovery (yes or no)	Yes
Predicted or measured annual energy use	2000 kW h

Customer Needs Metrics

	Metrics	House location in Pittsburgh, PA	Floor plan dimensions of 30' X 45'	One master bedroom and two sublet rooms	One large solar panel on roof of house for main power supply	R-value of 30 for wall and 25 for ceiling	Solar-Water Energy supply totaling less than 2000 kWh per year	6-inch overhang from roof off sides of house	4 windows for front view, 2 windows on side views	8- foot walls
Needs Statement		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
A House Located in Northeast US		x								
Floor Plan of about 1400 square feet			x	x						
Solar-powered Energy					x					
Lowest possible annual energy consumption							x			
Good Insulation to keep warm air trapped inside house						x				
House big enough for a family of 4				x						
Heated water supply					x		x			
Comfortable amount of windows									x	
House can keep sunlight from shining in								x		
One-Storie House										x

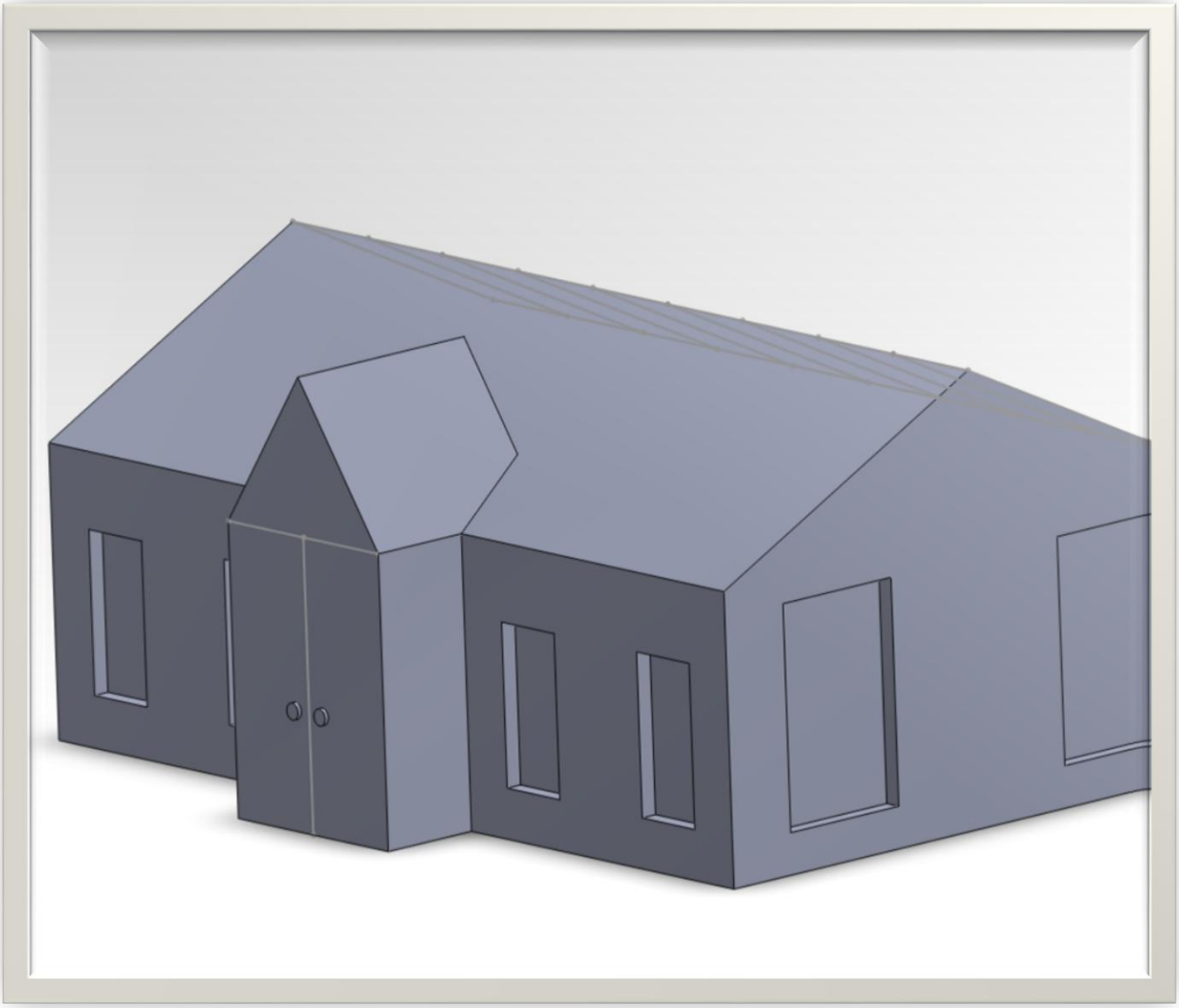
Multiview



Scale: 1:1 (Actual Build scale**: ¼’’:1’**)

Units: Feet (Actual Build Units: Inches)

Embodiment Design



Design Description

Our house is a one stories zero energy home for a family of three. There will be two rooms, a kitchen, a living room and a bathroom. The cost of the house will vary from $180,000 to $200,000. The house will have a solar panel on the roof that is capable of moving with the direction of the sun, because it has a hydraulic lift that helps it move 90 degrees so it can take as much solar energy as possible. We will have energy star appliances because their energy efficiency is significantly above the minimum efficiency standards set by the U.S. government. These appliances contribute to the houses reduced energy consumption and allow us to produce the necessary amount of energy.

The one solar panel the house will be having monocrystalline silicon which is costly but it is one of the most efficient solar panels today. There will be a solar heater that absorbs the heat energy from the silicon when needed.

The walls and roof will have an R value of 25 and 30. The windows will be large with double glazing and solar angles. This way the house will be warm in the winter, while in the summer there is tinting from the outside for blocking the sunlight.

Conclusion

The research we gathered in the duration of this project shows clearly the numerous elements needed for consideration when designing a Zero Energy Home. This project taught us a lot about design skills and teamwork. We believe the House we designed satisfies the customer needs, and meets the requirements to be considered a Zero Energy Home in the north east coast of the United States.

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