GREEN LAKE HOUSE

Knights of the Curved Table

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Overview

Basic Stats	
Location	State College, PA
House Size	3200 sq. ft.
# of Floors	2
# of Occupants	4-6
Heating System	Geothermal Heat Pump
Main Heating Fuel	Electricity
Photovoltaic System	10 kw
Conservation Stats	
Solar water heater	Yes
Wall Insulation	40
Ceiling Insulation	60
Ventilation Air Heat Recovery	Yes

Overview cont.

Goals of Project

- Function effectively as a team
- Use new knowledge to make informed decisions
- Create energy efficient home
- Be eco friendly

Conservation Features

- PV system
- Solar Water Heater
- Ventilation Air Recovery
- High insolation values
- Geothermal Heat Pump
- In ground design

Researched Homes

The Truro Home

Location (city, state)	Cape Cod, MA
House size (floor area in square feet)	6200 ft^2
Number of floors	1.5
URL of web site where info is found	http://www.modernhousearchitect.com/
Number of occupants	2- many
Number of bedrooms	7
Type of heating system (forced air, hydronic, radiant floor, heat pump, etc.	Geothermal, radiant heating
Main heating fuel (electricity, natural gas, wood, oil, etc.)	Electricity
Size of photovoltaic system (kilowatts)	11.7
Solar water heater (yes or no)	No
R-value of wall insulation	N/A
R-value of ceiling insulation	N/A
Ventilation air heat recovery (yes or no)	Yes
Predicted or measured annual energy use	Near net 0
Any other pertinent info	One half of the house is for use by family members, can be entirely shut down at other times to reduce energy consumption.

The Breezeway Home

Location (city, state)	Saltway City, UT
House size (square feet)	2800
Number of floors	2
URL	www.ourpassivehouse.org
Number of occupants	2
Number of bedrooms	1
Type of heating system (forced air, hydronic, radiant floor, heat pump, etc.	Electric resistance and solar thermal hot water tank with hot water coil in ventilation air stream.
Main heating fuel	Electricity
Size of photovoltaic system (kilowatts)	4.5
Solar water heater (yes or no)	Yes
R-value of wall insulation	N/A
R-value of ceiling insulation	N/A
Ventilation air heat recovery (yes or no)	Yes
Predicted or measured annual energy use	65 kWh/m2/year

Researched home cont.

Keithan House

Location (city, state)	Killingworth, CT
House size (floor area in square feet)	3,600 square feet
Number of floors	3
URL of web site where info is found	http://www.radiantrenewableenergy.com/index.php/case-studies/solar_photovoltaic_panels
Number of occupants	n/a
Number of bedrooms	n/a
Type of heating system	Radiant floor
Main heating fuel	Geothermal HVAC system
Size of photovoltaic system	65 Schuco
Solar water heater	Yes
R-value of wall insulation	R-42
R-value of ceiling insulation	R-62
Ventilation air heat recovery (yes or no)	No
Predicted or measured annual energy use	0

Mill Creek

Location (city, state)	Edmonton¸ albarta Canada
House size (floor area in square feet)	3267
Number of floors	3
URL of web site where info is found	http://greenedmonton.ca/MillCreekNetZeroHome
Number of occupants	4
Number of bedrooms	Unknown/ changing
Type of heating system (forced air, hydronic, radiant floor, heat pump, etc.	Baseboard heaters
Main heating fuel (electricity, natural gas, wood, oil, etc.)	Natural gas
Size of photovoltaic system (kilowatts)	1954
Solar water heater (yes or no)	yes
R-value of wall insulation	56
R-value of ceiling insulation	56
Ventilation air heat recovery (yes or no)	yes
Predicted or measured annual energy use	0

Energy Conserving Decisions (Researched)

Solar Electric

- 6-8 kw photovoltaic system is common
- Around 14w per sq. ft.
- Uses sun to make electricity

Solar Thermal

- Heats water in home using solar energy
- Typically 4′ x 8′ per two occupants

Windows

- Reflective glaze maximize passive solar energy
- Non metal frame
- Multi pane glass

Walls

- R value for insolation between 15 and 40

Roofing

- Pitch at solar maximizing angle
- R value of insolation around 60

Heat ventilation recovery system -recycles house heat

House Efficiency

Heat loss

Appliances

Appliances cont.

Appliances cont.

Photovoltaic System Specs

Heat pump

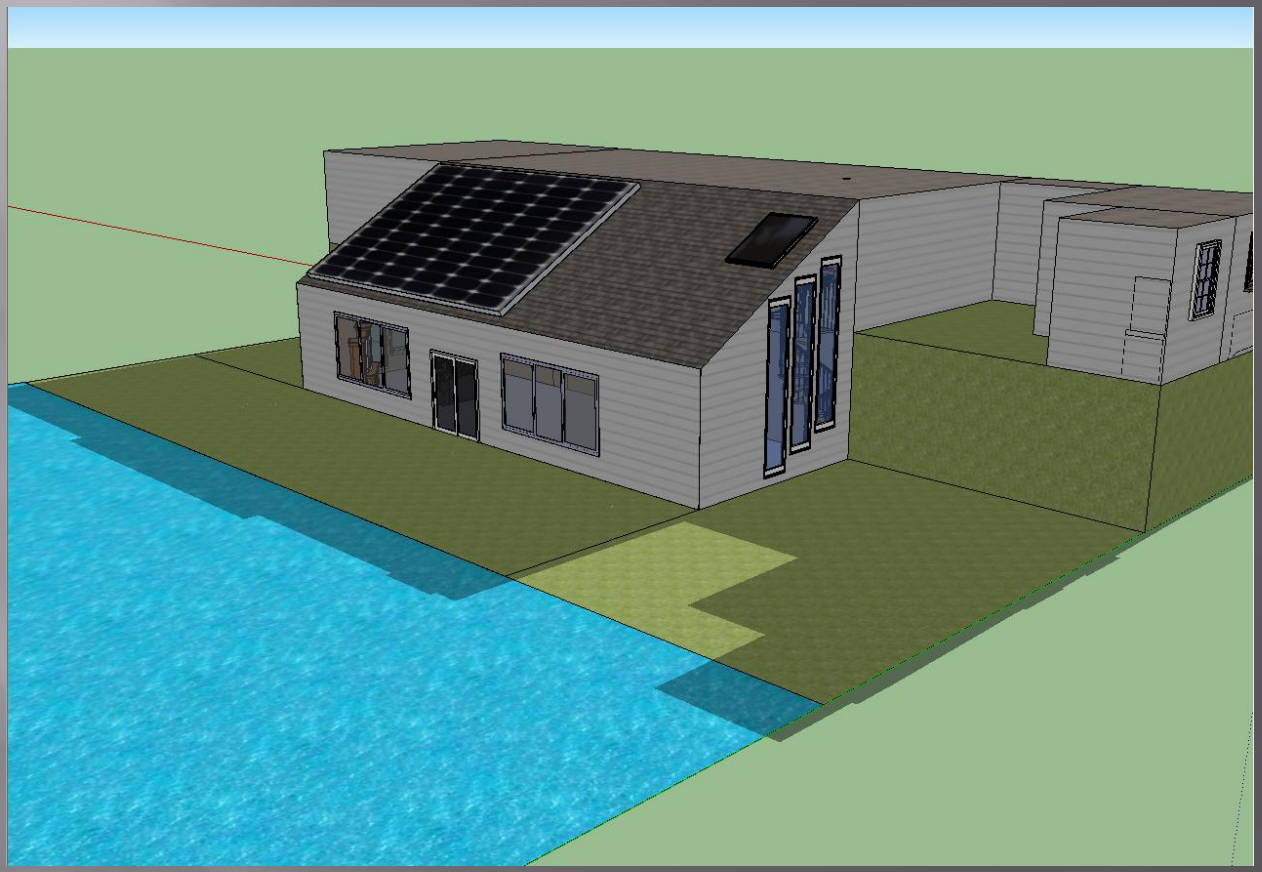
Overall energy cost

Conservative Measures

Sketchup Model

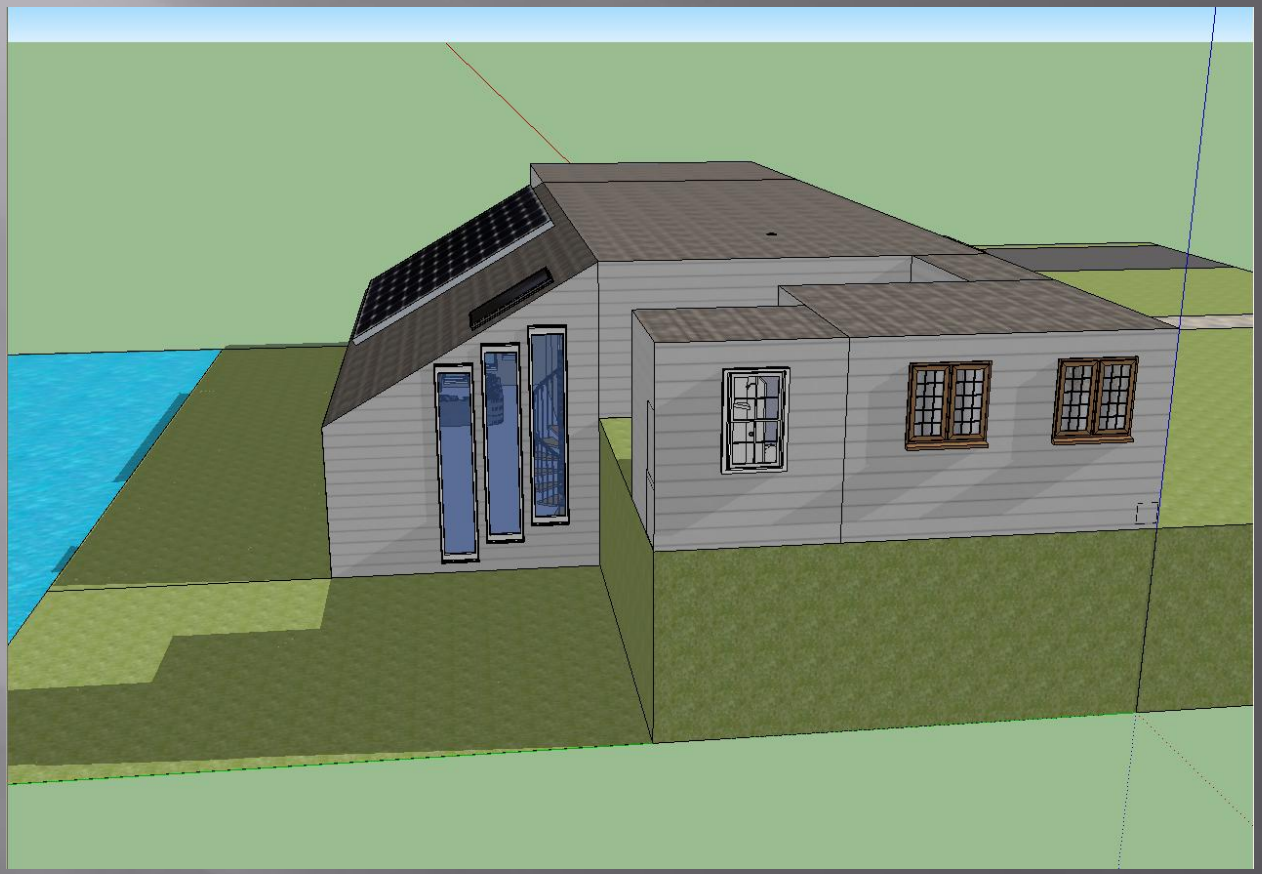
January 1st Front View

Sketchup Model



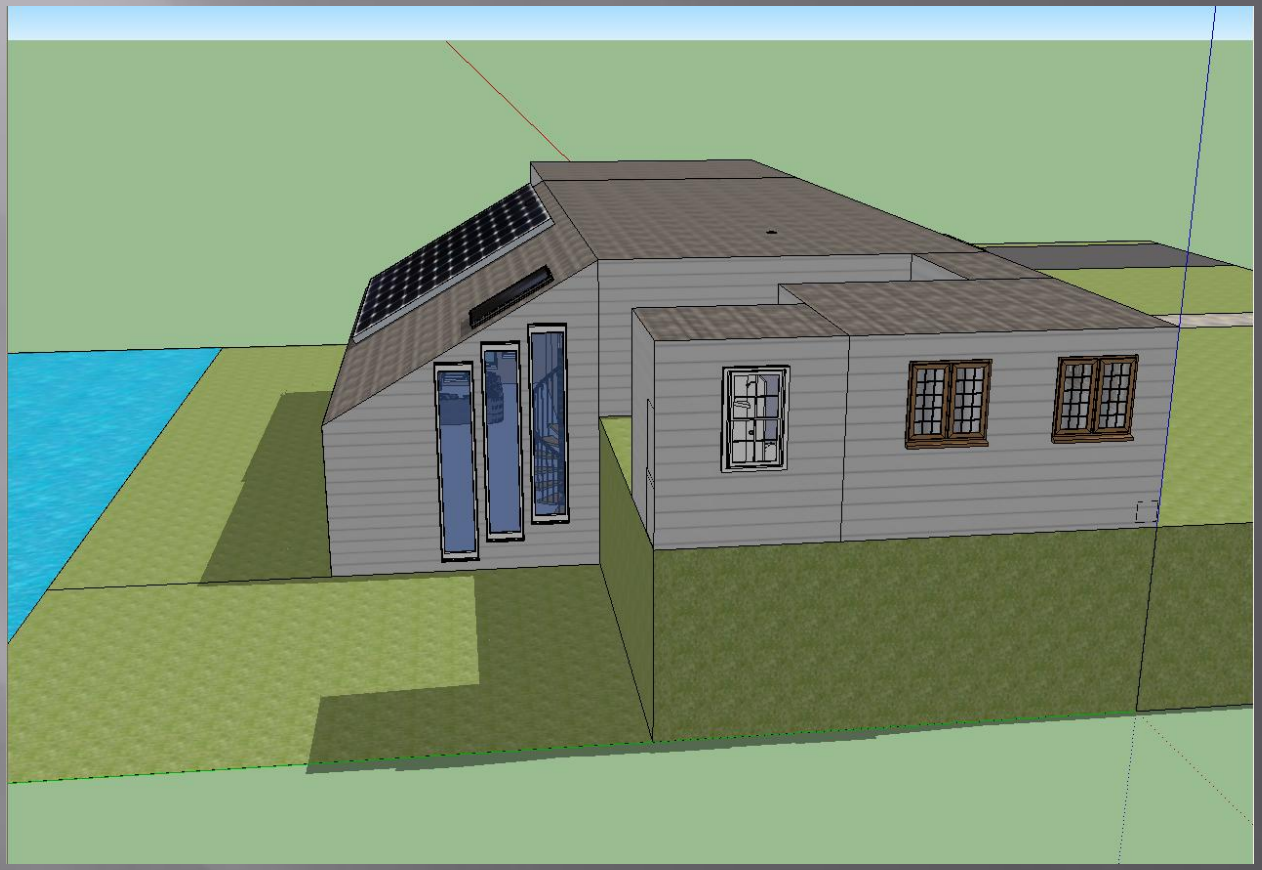
January 1st Rear View

Sketchup Model



November 21st Side View

Sketchup Model



March 21st Side View

Sketchup Model

Interior

Sketchup Model

Interior

Physical Model

Front

Physical Model

Rear

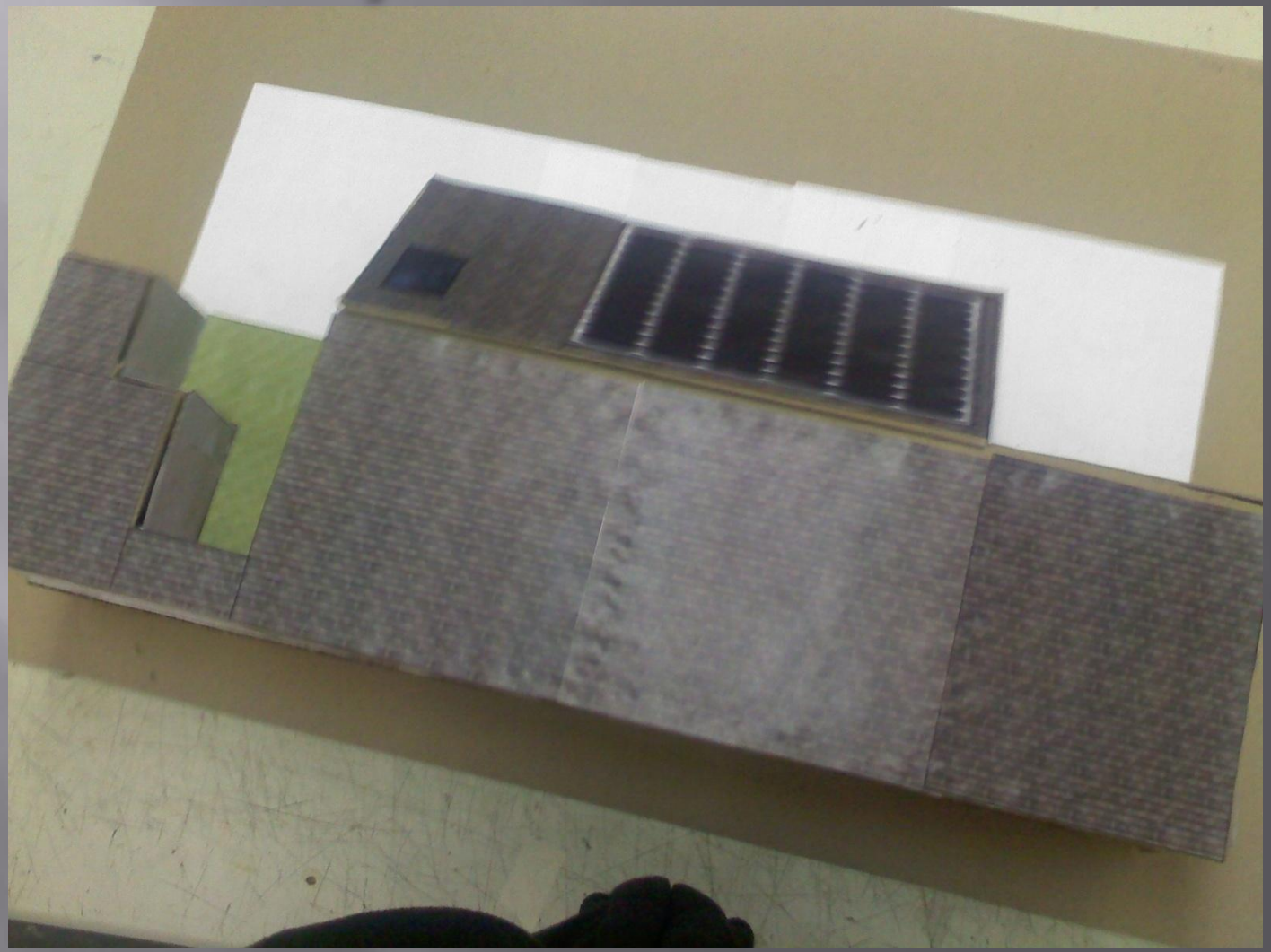
Physical Model

Side

Physical Model

Layout

Physical Model



Top

Summary

- The Green Lake Home stresses efficiency, style, and modernism.
- Open floor plan allows for heat to spread easily throughout the house.
- Due to Ground Source Heat Pump, PV system, solar water heater, and other conservative practices, the Green Lake Home feeds more energy into the system than it requires.
- Large PV array and 30° roof pointed south allow for maximum use solar energy.

Cost Analysis – Heating System

- Electric Resistance
  - Install cost: $2,000 (HVAC HW)
  - Energy use with Electric resistance heating system (ZEH Calculator): 13500
  - Annual Cost (Total Electric): $1352
  - Energy provided by PV system:13140
  - Exceeds PV system output, no longer a ZEH!

- Geothermal Heat Pump
  - Install Cost: $15,000
  - Energy use with GHP (ZEH Calculator: $8846
  - Annual Cost (Total Electric): $885
  - Annual Savings (vs. Electric Resistance): $467
  - Annual energy savings: 4654 kwh

<u>Economics:</u>

- Payback Time
  (2000 – 15000)/(-467) = 27.8 years
- Kwh saved would allow for credits back from electric company.
- Tax incentives provide more return.

Reflection

- Through the Green Lake Home project we are now more aware of design decisions that must be made when building a home, and the various technologies available to conserve energy.
- The various systems of a Zero Energy Home can represent how other engineering systems can compliment each other within a larger system, as well as being efficient, and environmentally less ******.
- Solar energy is a vast and powerful resource that can be harnessed in many ways, the mode of production is completely clean (the Sun!). Although the production of photovoltaic cells is not.
- Zero Energy Homes, although costly to build, have numerous payback incentives and leave much less impact on the environment.
- The teams performance could improve by having more initial concepts and brainstorming sessions.
- In SketchUp, simplicity rules.