ECO-STRUCTURE

GADDY HOUSE
11232 Old Hopkins Road
Clarksville, MD 21209

GENERAL STATEMENT

- The client selected the home site because it is within walking distance of his workplace, has excellent solar access, and was previously developed. While he seriously considered remodeling the site's existing cottage, its age and condition precluded goals of net zero energy, excellent indoor air-quality, and accessibility that would facilitate aging in place.

- Building type: Single Family House

- Location: Clarksville, Maryland

- Area:
  - 2072 ft^2 home
  - 928 ft^2 storage under solar panels
  - 614 ft^2 garage

- Estimated completion: 31 December 2012

- Lot: 1.22 acres zoned rural residential

PERFORMANCE DATA

- Energy efficiency strategies:
  - super insulation
  - passive solar design
    - orientation
    - tuned shading
    - SHGC's of glazing.
  - Appliances and fixtures were chosen for energy and water efficiency

- Results:
  - exceeds the Passive House energy standard
  - 90% more efficient than standard construction with respect to heating and cooling
  - total site energy reductions of 70%
  - 91% net positive source/primary energy including renewable contributions.

- Data
  - Building gross floor area: 2,072 ft^2
  - Number of permanent occupants and visitors: 3
  - Percent of building that is day lit: 88%
  - Percent of the building that can be ventilated or cooled with operable windows: 94%
  - Total indoor water use (gallons per year):
    - 11,353 per person
    - 34,033 for three people
  - Calculated annual potable water use (gallons per square foot per year): 16.4
  - EPA Performance Rating: HERS Index = 0
  - LEED rating: Seeking Platinum
  - Total Project Cost: $613,325 exclusive of lot.

GOALS

- Safe
    - No stairs
    - Terraced steps
    - No combustion
    - Secure doors and windows
    - Excellent air and water quality
    - Building science analysis to ensure against condensation (interior or interstitial) and associated mold, mildew and building failure.
    - No harmful materials
    - Radon venting
    - Close to community services

- Environmentally benign
    - Carbon neutral
    - Low water consumption
    - Solar arrays
    - Construction materials harmless to the environment
    - No petrochemical insulation, fertilizers or pesticides
    - High rain-water retention
    - Chesapeake Bay watershed native plants
    - Termite control with borate and bait

- Comfortable
    - Accurate temperature and humidity control
    - Pleasant natural and artificial lighting
    - Appliances and insulation selected for quietness

- Low maintenance house and yard

- Appealing appearance

ENERGY USE (Btu ft^{-2} yr^{-1})

- 3.57 for heating
- 0.50 for cooling
- 3.87 for electrical,
    - All LED lights
    - Refrigerator at 254 kWh/yr
    - Dishwasher at 180 kWh/yr
    - Induction cooktop
- .87 for domestic hot water after solar thermal contribution
- 8.82 total energy consumption
- 15.82 energy production from PV's
- 7 net positive energy production at site
- Energy model accounts for source energy (Primary Energy) for carbon footprint analysis
- Source Energy or PE=16.6
- PV Source energy offset=31.7
    - Net positive Source Energy by 91%
- Energy model = Passive House Planning Package (PHPP)
- PV Estimates from PVWATTS, v. 1
- Switches installed for some outlets to prevent stand by losses.

WATER USE

- Fixtures:
  - 2 toilets using 0.8 gpf
  - 1 waterless urinal
  - 2 shower heads rated 1.5 gpm
  - 1 kitchen and 3 lavatory faucets rated 1.0 gpm

- Appliances:
  - Dishwasher rated at 2.22 gallons per cycle
  - Clothes washer rated at 6.77 gallons per wash

- Drought tolerant native plants

Use	*Gallons day^{-1} person^{-1}*
Toilet	3.37
Urinal	0.00
Clothes Washer	2.50
Showering	8.40
Baths	1.19
Lavatory Faucet	5.00
Kitchen Faucet	4.00
Dishwasher	0.22
Leaks	4.80[1]
Other Domestic Use	1.60
Total Indoor Use	31.08

[1] From AWWA Metrics Guidance Report Jan-22-2010; expect less due to monitoring.

MATERIALS

- Foamglass used under the foundation has high compressive strength to support the building yet provides for thermal isolation
- Fiber cement and galvanized metal siding for low maintenance
- Metal roof for low maintenance and recyclability
- Recycled content, urea formaldehyde free, dense pack, fiberglass insulation
- Stainless steel counter top for recyclability and low off gassing
- No:
    - arsenic
    - asbestos
    - cadmium
    - lead
    - mercury
    - chlorofluorocarbons
    - petrochemical fertilizers
    - petro chemical pesticides

INDOOR AIR QUALITY AND DAYLIGHTING

- ERV
  - Filtered air
  - Generous air make-up
  - Balanced vetilation
- Low VOC materials throughout
- Detached garage
- Sixteen operable windows
- Generous overhangs to allow for open windows during rain
- Large south facing windows with
  - Shutter shades to reduce glare and extraneous heat
  - Shading from generous overhang to keep out summer sun and let in winter sun
- All LED lights for quick startup and good light quality

SITE SELECTION

- Grounds of client's employer are less than a 3 minute walk

- Unobstructed southern view

- Lot is above 100-year floodplains
- away from wetlands
- Not on land that was public parkland
- Was previously developed

- Located within
    - Walking distance, 0.4 mile of:
        Forest preservation area
        Bank
        Elementary and middle school
    - Bicycling distance,
        1 mile of 5 more community resources
        2 miles of more than 8 additional community resources
    - 6 miles of a major shopping mall (Columbia)
    - 20 miles of an International Airport (BWI)

GRANTS AND INCENTIVES

- County property tax credits:
  - 100% first year
  - 75% second year
  - 50% third year
  - 25% fourth year

- $1,600 rebate from utility company for HERS of zero

- First year for solar panels
  - $13,917 Federal income tax credit
  - $1,000 Maryland solar energy grant program
  - $2,049 from sale of solar renewable energy credits (SRECS)

- Long term incentives for solar panels
  - $53,881 savings over twenty-five years of utility bills
  - $21,104 over 15 years from sale of SRECS
  - These do not include cost of money

POST OCCUPANCY PERFORMANCE MONITORING

- First three years
    - Annual blower door and thermal imaging evaluation

- Monitor and record minute by minute using Agilent 34972A and appropriate sensors:
    - Electrical consumption:
        - Heat pump
        - Hot water heater
        - Appliances
        - Well pump
        - All other circuits
    - Solar panel energy production
    - Temperature at ERV intakes and exhausts
    - Temperature at other locations
    - Humidity at a minimum of three locations
    - Irradiance
    - Outside temperature
    - Outside air speed

- Auto summarize monitored data into useful reports

- Custom software for the monitoring and reports

- Alerts for poorly functioning equipment

INNOVATION

- Foamglas footing insulation
- Automatic exterior shades to prevent over-heating
- architecturally integrated Solar panels
- automatic solar thermal collector shades to prevent summer overheating
- TJI stud wall structure
- Panelized pre-fabrication
- Partial re-use of existing structure reducing unnecessary fill
- Highly insulated slab
- thermal bridge free envelope
- Mineral wool continuous insulation to avoid environmental and health impacts of rigid board foam.
- 83% efficient ERV ventilation system with “passive” ground loop
- Storm water management designed for onsite infiltration of 10 year storms
- Landscaping to support declining pollinator and bird populations
- Onsite active composting
- Preservation of most mature trees including one totally awesome black cherry