



Building a (Net) Zero Energy Home

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7 May 09



Getting to This Point

- Where we live: New Paltz, NY (90 mi north of NYC)
- Searched for a house over a year
- Increasingly found ourselves looking for energy efficiency features
- Frustrated by the lack of options on the market
- More and more “Energy Star” homes, but all focus on different things...none provided comprehensive approach

Discovered a Committed Builder and Architect

NEW PALTZ TIMES • THUR

Green Acres

**DEVELOPER TO BUILD
'ZERO-ENERGY' HOMES
IN NEW PALTZ**

While many contractors might be gun shy to build houses with the real estate crash and skyrocketing fuel costs, Anthony Aebi, owner of 25 lots on 10 acres of land behind Bontecou View Drive in New Paltz, is gung ho and going green.

Not only is Aebi going green he's going for "zero energy" – the highest state and federal ranking for energy-efficient homes.

"I just built a 4,000-foot zero-energy house in Esopus, very high-end, and it received the only perfect score for Energy Star ratings in New York State," said Aebi, who has teamed up with architect David Toder to design zero-energy homes at a New Paltz development called "Green Acres."

A zero-energy home means that what the structure produces and uses evens out so that there is no extra energy being siphoned off the utility grid.

According to his project manager, Edgar Osis,



Owner Anthony Aebi and architect Dave Toder on Green Acres.

Important Firsts

- Green Acres is the first truly zero energy community outside of California
 - Others are “planned” and have no occupants...
 - ...or claim zero energy but are actually near zero energy
- Our home is Anthony Aebi’s first occupied zero energy home
 - He built the first EnergyStar-certified zero energy home in New York (Esopus)...but it was a model home initially and remains unoccupied



What is a Zero Energy Home (ZEH)?

- Means that once the home is built, the occupants consume no more energy than the home itself produces
- How does it accomplish this?
 1. Solar panels
 2. Geothermal heating and cooling
 3. Superior insulation and sealing
 4. Heat recovery ventilation

Solar Panels



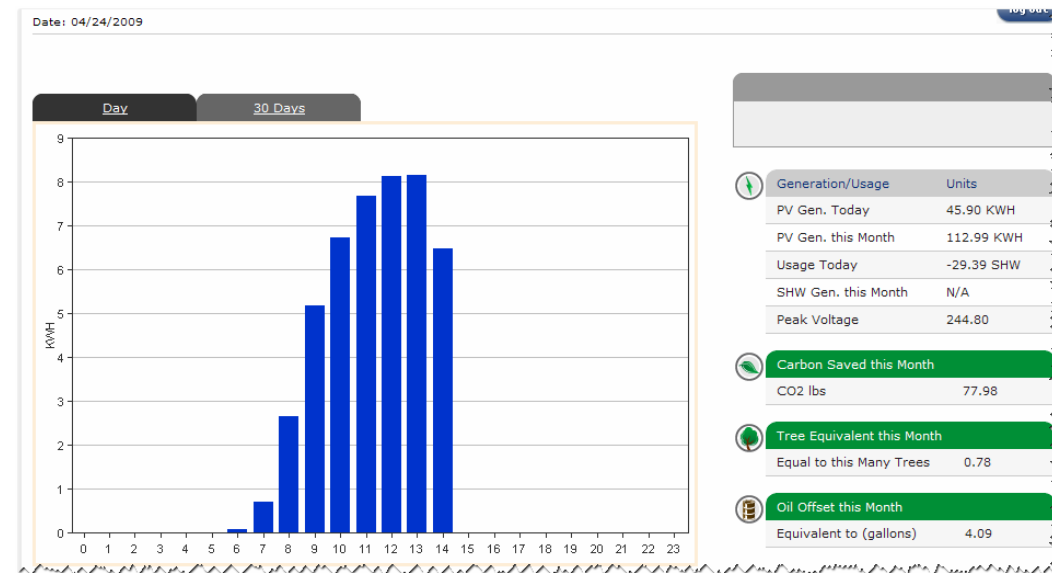
- We chose an upgrade to a 10 kW system to ensure extra capacity to accommodate a plug-in hybrid or electric vehicle some day
 - Hudson Valley Clean Energy (HVCE) assessed home
- Will provide ~33 kWh/day on average

Hours of Sun (noon time equivalents)												
Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Year
2.7	3.6	4.4	5	5.5	5.8	6	5.5	4.8	3.7	2.4	2.1	4.3

Source: National Renewable Energy Laboratory IMBY Tool

- Economics of PV in State of New York
 - Solar panel cost (10 kW): \$85,455 (~\$8.50/watt installed)
 - Estimate the total of rebates and incentives to cover 70% of cost
 - State rebate: \$40,000 (with EnergyStar home rating)
 - State tax credit: \$5,000
 - Federal tax credit: \$13,636.50
 - Total after all incentives: **\$26,818.50**
 - No electric bill – NY has highest cost of electricity in continental U.S. (\$ 0.15 kWh)
 - Estimate \$120/month savings in electricity alone (much more savings from zero gas/oil)
 - Chance for more if we produce more than we consume in a year (sell back at wholesale prices)

Solar Panels



Web-based home power monitoring system

Geothermal Heating and Cooling

- Technology: Ground Source Heat Pump (GSHP)
- What is a ground source heat pump?

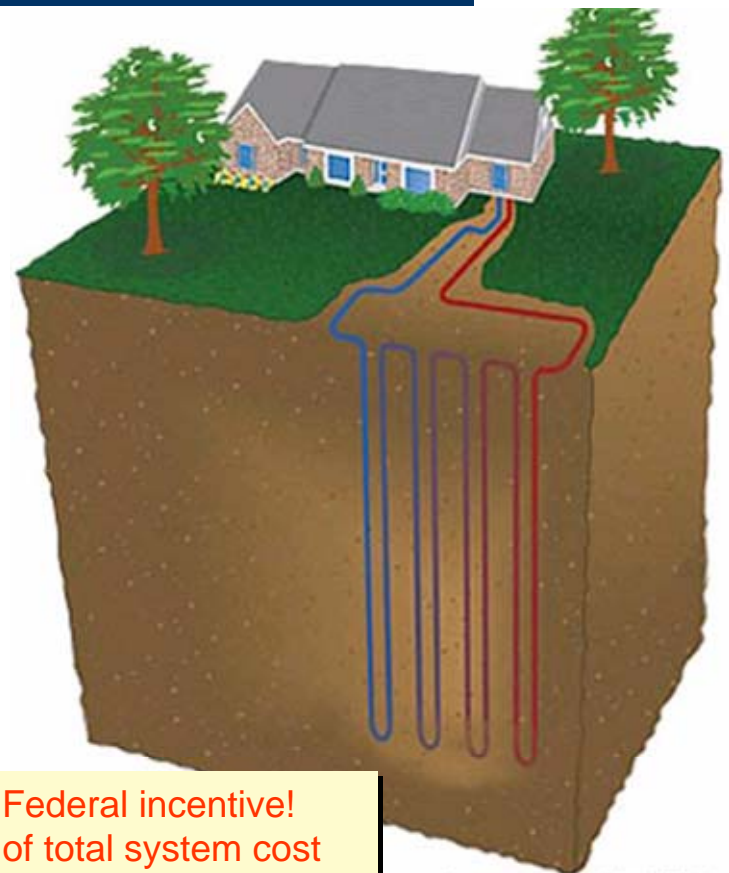
Ground source heat pumps (GSHPs) are electrically powered systems that use the earth's fairly constant temperature to provide heating, cooling, and hot water for homes and buildings.

- How do ground source heat pumps work?

Ground source heat pumps have closed loops that can be installed either horizontally, vertically, or in a pond/lake. The available land areas and the soil and rock type at the installation site will help determine the most economical choice (system type) for installation of the ground loop.

An antifreeze solution is circulated through plastic pipes buried beneath the ground for closed loop systems. The fluid gathers heat from the earth and circulates it through the system and into the building. During the summer, the system reverses itself and pulls heat from the structure and places it in the ground.

- Efficiency
 - Heating: 50 to 70% more efficient
 - Cooling: 20 to 40% more efficient
 - Hot Water: free hot water in the summer and considerable savings on hot water in the winter.



New Federal incentive!
30% of total system cost
returned as tax credit

Image courtesy of ClimateMaster

Geothermal Heating and Cooling

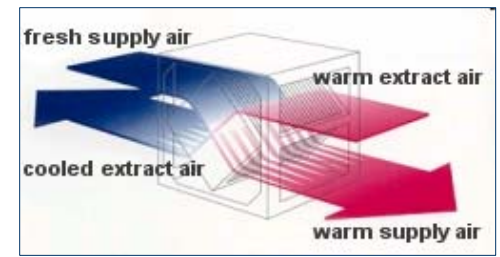


Geothermal Heat Pump



Pre-tempered water tank

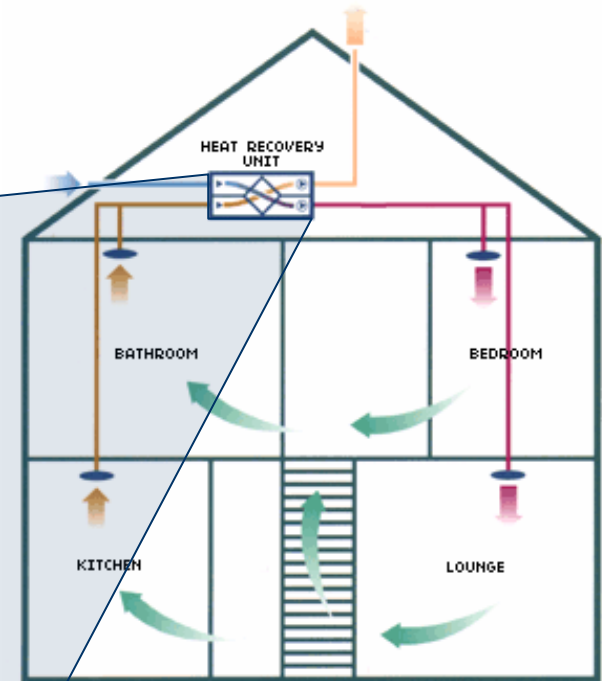
Pipes to 500-ft-deep closed loop well



Winter-time Exchange

Heat Recovery Ventilation

- Exchanges energy from indoor, conditioned air to incoming outdoor air
- Recovers 60-80% of energy
- Also provides superior ventilation



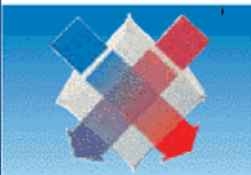


Core: Heat Recovery Units feature a lifetime warranty on the aluminum core.

Washable Electrostatic Filters

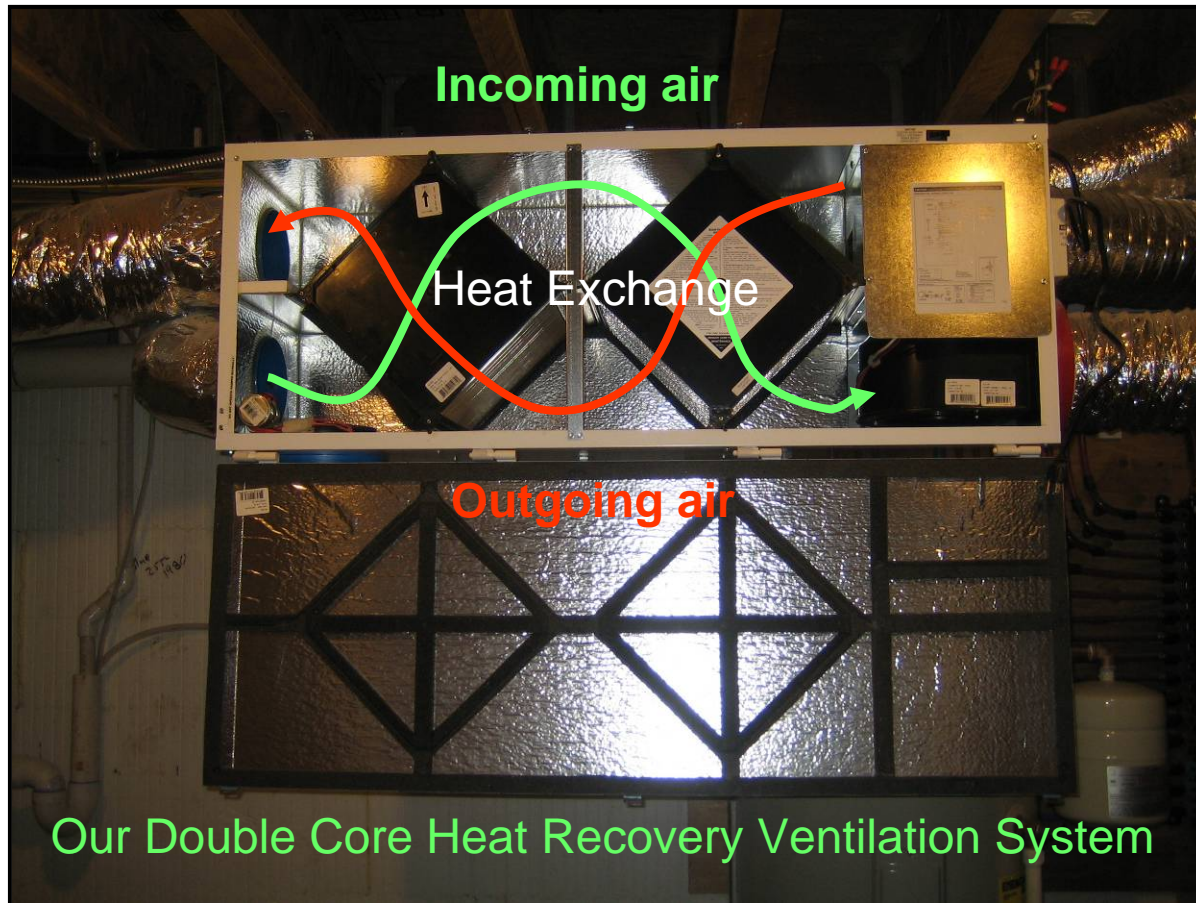
Superior EBM Motors: Units are designed with German manufactured EBM external rotor motorized impellers – the most durable motors in the industry. Precise balancing ensures vibration-free operation. No maintenance needed. 7 Year Limited Warranty.

Fully Insulated Cabinet: Baked powder-coat finish. Insulated with 1" (25mm) foil-faced, high density polystyrene foam. For quiet, trouble-free operation.

Electronic Control Board: Units feature state-of-the-art control boards for easy connection to existing HVAC equipment. All units are designed for easy operation from a series of optional remote controls.

Heat Recovery Ventilation



Insulation

- Walls
 - ICFs provide tremendous performance ($> R-30$) – air tight
- Windows
 - Low-E, triple pane, Argon filled
- Basement
 - Slab – Double insulation (R-20)
 - Walls – fully insulated with ICF
 - Studies indicate 40% of home energy loss through basements
- Roof
 - Sprayed icynene foam (R-38)
- House highly sealed
 - No wall leakage
 - Maximum seals on doors/windows
 - Homes average 35% air exchange/hr. Our home $< 7\%$.



*Insulated Concrete Form (ICF)
[Styrofoam surrounding concrete]*

ICFs Assembled to the Peak



Concrete Poured into Stacked Insulated Concrete Forms

The Complete System of ZEH

D. Other energy efficient features:

- Lighting
 - CFLs, LEDs
 - Dimmable
 - Outdoor motion detectors
- Strategic switches – entertainment center

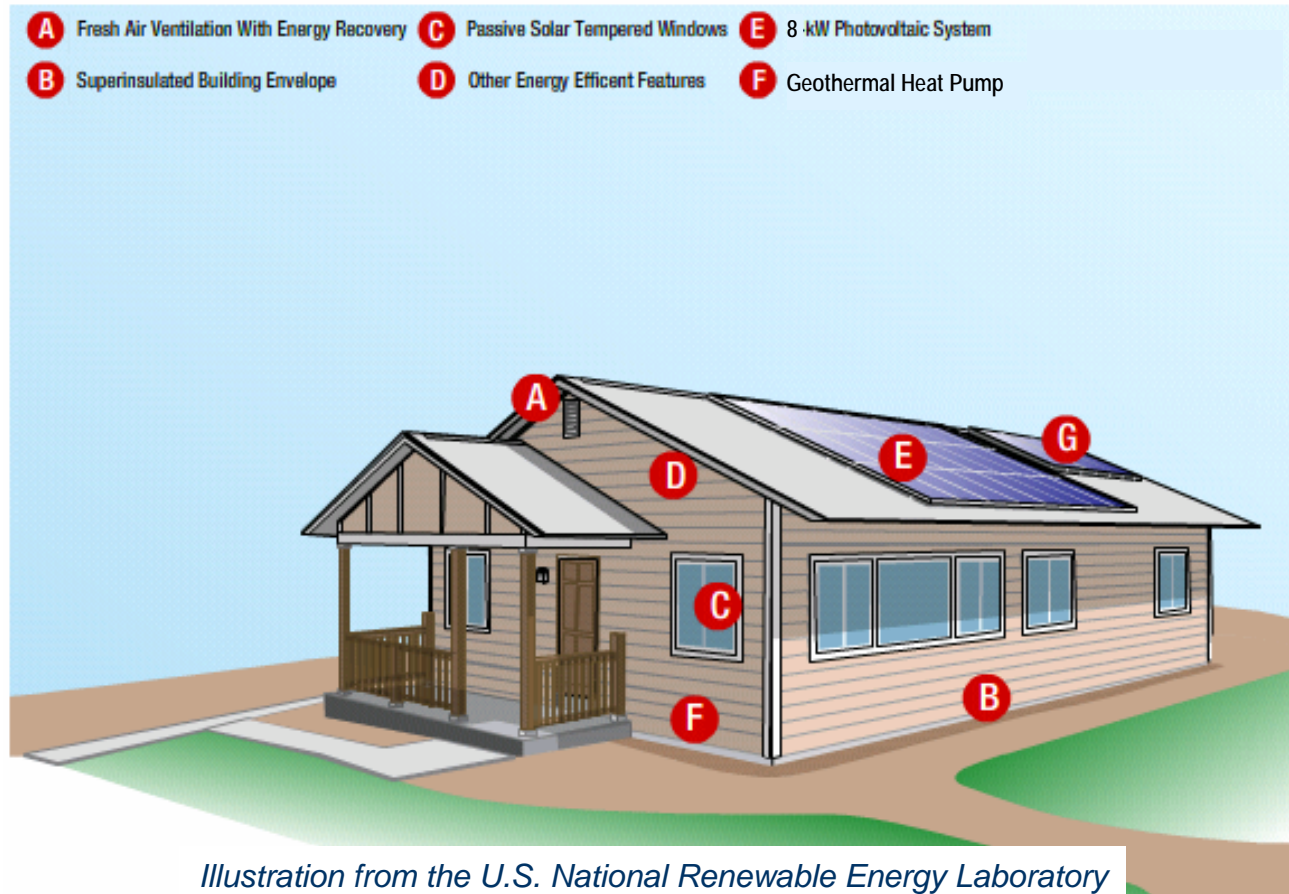
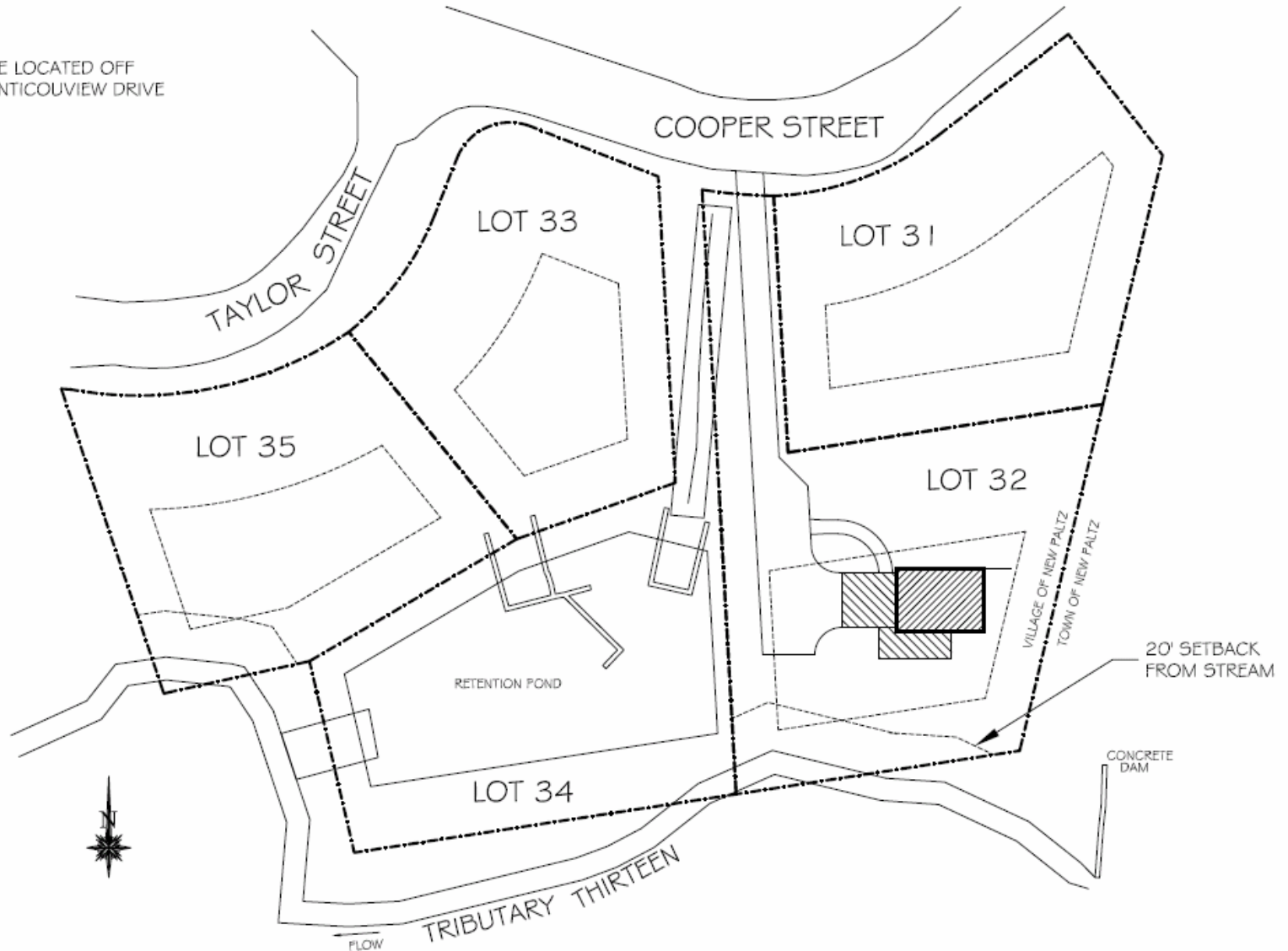


Illustration from the U.S. National Renewable Energy Laboratory

Site Plan

SITE LOCATED OFF
BONTICOUVIEW DRIVE



SITE PLAN

SCALE: 1" = 60'

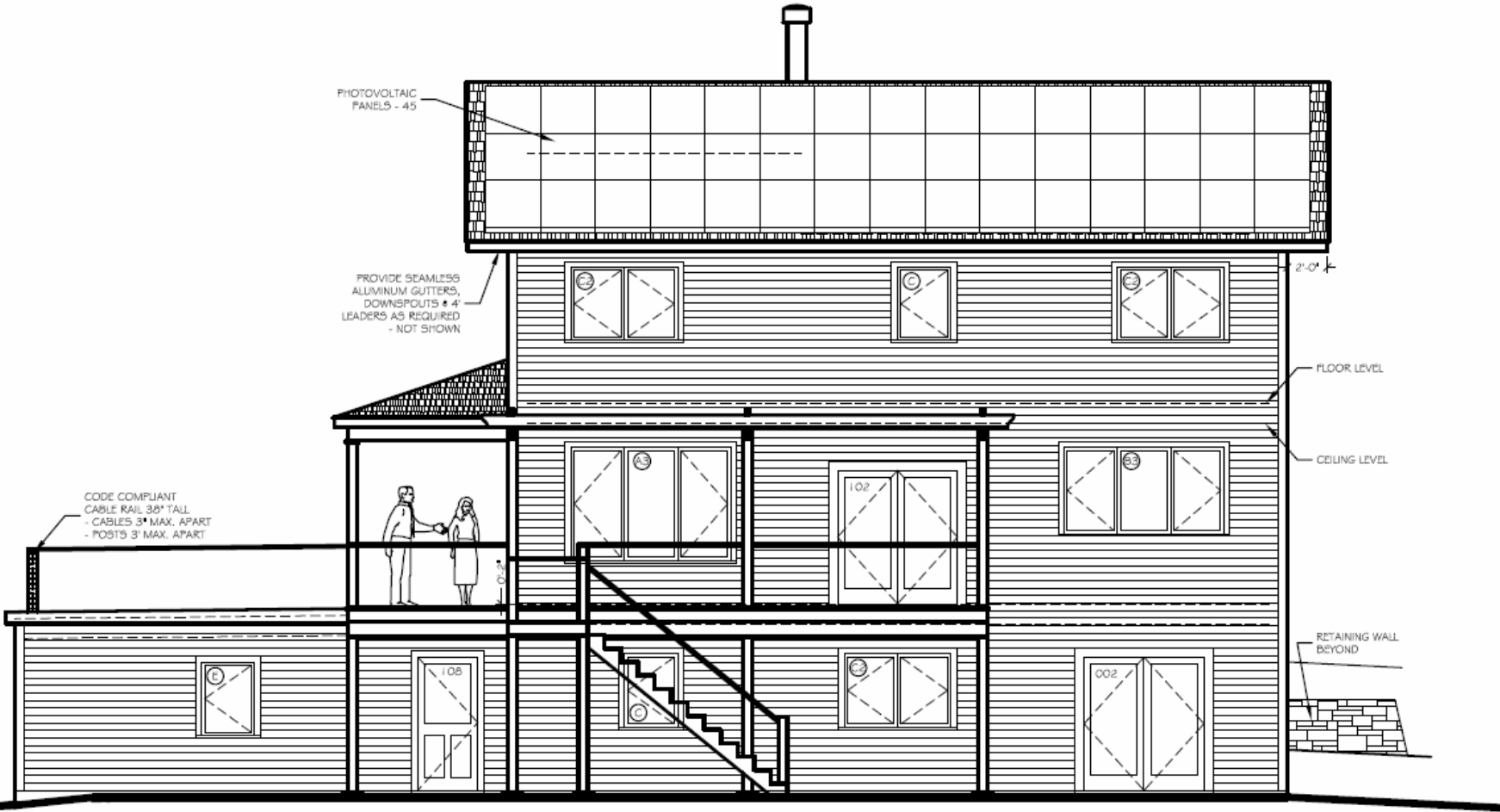
THIS SITE PLAN, BASED ON A SURVEY BY BARRY MEDENBACH, PE,
OF MEDENBACH & EGGERS, PC, OF STONE RIDGE, NY, DATED MARCH 19, 2019,
IS SCHEMATIC IN NATURE AND IS NOT INTENDED FOR USE AS A FORMAL SURVEY.

West Elevation

Worked with an exceptional architect (David Toder) who was able to balance energy efficiency goals with superior design and aesthetics.

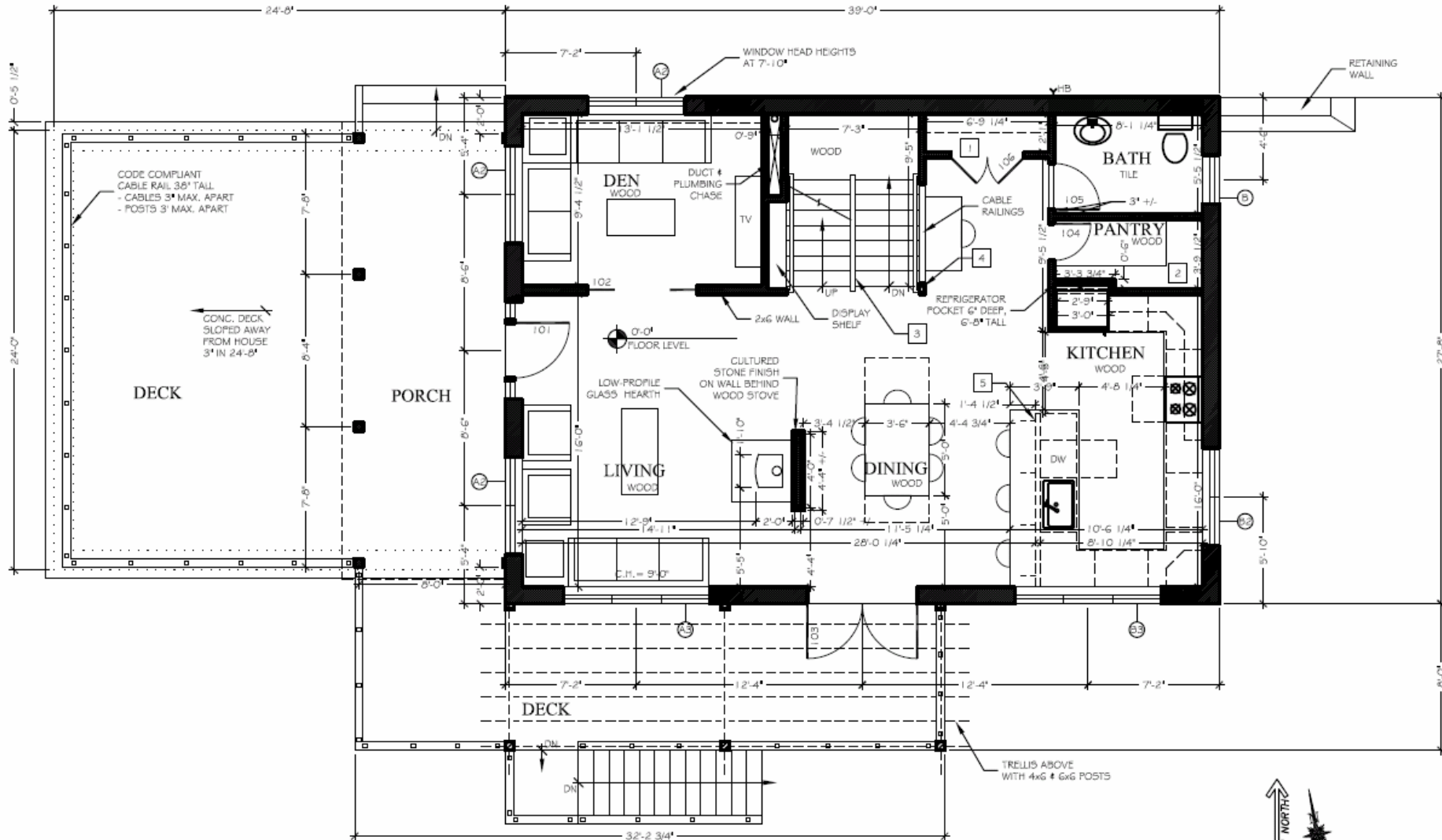


South Elevation



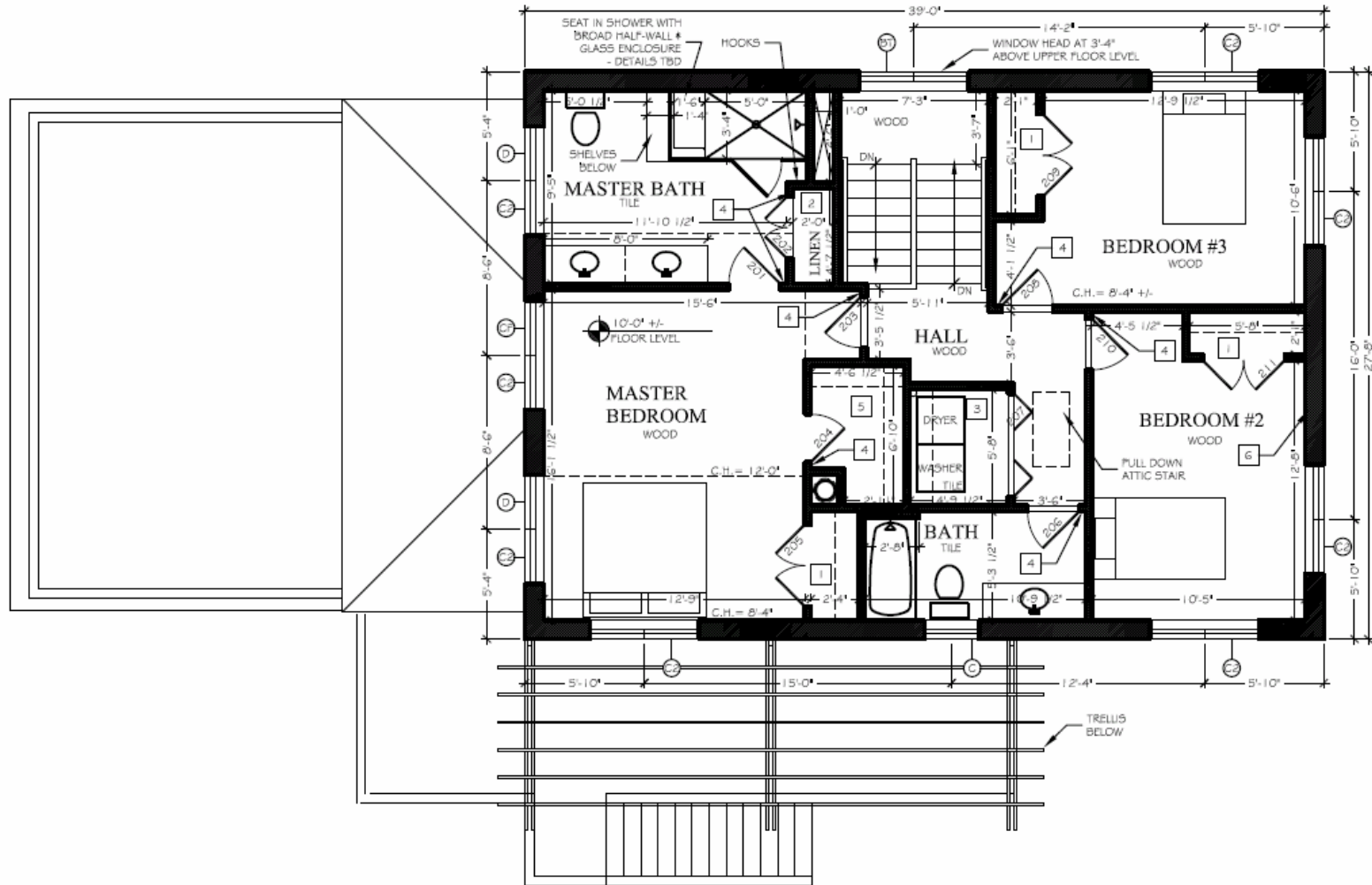
5 SOUTH ELEVATION
SCALE: 1/8" = 1'-0"

Main Level (2) Floor Plan



1 MAIN LEVEL FLOOR PLAN
SCALE: 1/8" = 1'-0"

Top Level (3) Floor Plan



Cleared Lot – Aug 08



Breaking Ground – 4 Sep 08



About to Build Foundation – 11 Sep 08



Three Floors Framed – 29 Oct 08

Concrete Garage

ICFs

More pics: <http://picasaweb.google.com/sheplerd/13CooperStreet#>

Taking Shape
12 Nov 08

Solar Panels in
Mar 2009

Geothermal Well

ICFs

More pics: <http://picasaweb.google.com/sheplerd/18CooperStreet#>




Getting There

29 Jan 09





**Fully Functioning
Zero Energy Home!
15 Apr 09**

A two-story house with light green horizontal siding and white trim. The house features a gabled roof with three large white-framed windows on the upper level. A covered front porch with a grey shingle roof is supported by wooden posts and has a metal railing. Below the porch is a two-car garage with white doors. The house is set on a gravel driveway with a stone retaining wall in the foreground. The background shows a wooded area with bare trees under a blue sky.

**Home Sweet
(Zero Energy) Home!
15 Apr 09**

Economics of ZEH

- We estimate the home costs 10-15% more, thanks to government incentives.
- Federal and state incentives
 - **Solar** – 70% paid for through incentives (rebates and tax credits). Federal tax credits much more aggressive in 2009!!!
 - **Geothermal** – new Federal tax credits (30% of total system cost!) in 2009, thanks to the American Recovery and Reinvestment Act of 2009
 - Other efficiency features – no (or very little) incentives
- Ongoing savings
 - We anticipate saving ~\$5,000/yr (oil, gas, electricity) immediately
 - These savings will grow as oil, gas, and electricity prices continue to rise
- Other benefits
 - Very comfortable, quiet house – constant “free” temperature of 72°F
 - Psychological reward of living green
 - Increase property value

Increased property value, utility savings, and limited incentives makes it a worthwhile investment

Public Policy

- No comprehensive incentives for zero-energy building (ZEB) in U.S.
- Congress expanded the tax credits offered for solar and other efficiency systems for 2009! (geothermal now included)
- With the new administration, considerable changes should be coming: President Obama promises energy independence “within 10 years”, largely through investments in renewables
- Current standards
 - **Energy Star** – fairly minimal, but recognizable name
 - **LEED** – Leadership in Energy and Environmental Design (U.S. Green Building Council)
 - Focuses a lot on total impact to environment – recyclable materials, environmentally sound materials (radioactivity, vapors, etc.). Energy consumption is only one piece
 - We seek Energy Star Compliance (simple) and LEED Platinum (harder)

Questions I have

- **Appraisal System:** How do we modernize the appraisal system to properly value energy features?
- **Bleeding Edge Concern** - Have you heard of other ZEH communities in the U.S.? In the world?
("Passivhaus" in Germany)