

Major Specifications of Solar Harvest, 1887 Orchard Ave., Boulder

In November 2005 Eric Doub and family moved into their demonstration home at 1887 Orchard Ave in Boulder. Named "Solar Harvest," the home was predicted to become the City of Boulder's 1st Net-Zero Energy Home. Result: **Verified 2 years as NZEH on a source basis; expected to meet the site-basis standard in 2008.** Specifications include:

- Solar Electric: 6.84 kW Sharp Photovoltaic array, grid-tied, with half the panels on 20-degree roof and half on 40-degree roof; 1.9 kW E- and W-facing, added 9/07
- 12 solar thermal flat-plate collectors, at 55 degrees, in a drainback system
- 6,000-gal. solar storage, super-insulated and with 3 heat exchangers for hot water, staple-up radiant floor space heating, and spa
- 275 sf of sunspace vertical glazing for passive gain, with distribution ducts and electro-commutated motor fans
- Double 5/8" sheetrock on all walls and ceilings except stairs and hallways, for distributed, indirect thermal mass
- A design heat load of about 29,000 BTUs/hr., for the 3,400 sf above-ground home (plus basement with radiant tubes in the slab)
- Extensive, engineered ERV (energy recovery ventilation) system: Fresh air supplies in each bedroom, for example. Direct exhaust to exterior from bathrooms and kitchen. Natural ACH measured at 0.09
- Intake air to ERV/fresh air system to run through 260 feet of thin-wall 6" PVC pipe, buried outside at between 6 and 8 feet to preheat winter air and provide cooler air entering the home during summer months
- Minimized emissions from building materials -- formaldehyde-free cabinets and carpet, AFM Safecoat paints and stains, low-odor floor finishes
- Healthy home consulting by Baubiologist Pete Chandler of Living Space.
- Salvaged materials include hardwood flooring, all bathtubs, interior doors, cabinets and sinks, and windows in garage and interior walls
- Fibertec (Canadian) fiberglass windows with glazing by Alpen (Boulder), with overall unit NFRC U-values of 0.18 on the west and east, and 0.12 on the north (not a typo!), and extremely low air leakage ratings. (With an outside temp of zero F and 15 mph wind, with indoor 70 deg F, the interior surface of such glass is 64 deg F.)
- Roofing by Nycore made of 100% recycled carpet -- looks and functions like slate, but is walkable & has a 50-year warranty
- Natural gas used only for range and clothes dryer thru 10/07; now ALL-ELECTRIC HOME
- FSC-certified Pau Lope railing material; ACQ treated lumber for sill plates and landscaping ties
- Primary insulation by Icynene, with 1" rigid foam on outside of perimeter walls, and 1.5" resilient channel at 24" on center across all wall-framing members. Walls about R-34 and ceiling R-60, THERMALLY BROKEN. Basement walls are Greenblock ICFs with alleged R-30
- Summer cooling by Tamarack attic fans and natural "chimney" effect of airflow through operable skylight in hall of top floor. Coolerado evaporative cooler added 7/07, 60% for lifestyle reasons (opening & closing shades & windows less critical; very low electrical usage)
- Daylighting and electric lighting designed by Clanton Engineering, using state-of-the-art pin-type CFLs, with occupancy sensors
- (written pre move-in, 10/05) "Engineering calculations show that no backup heating system appears to be necessary for a period of about 8 cloudy (no solar gain) days with temperatures at zero deg F, 24/7. While this is the most likely practical outcome of how the home is built, and there are no records of Boulder's climate being this challenging, Boulder code (like the national code) requires non-portable heating facilities that maintain 68 degrees throughout the house.* Solar Harvest will therefore have electrical wires and circuits, and natural gas, roughed in the mechanical room, ready for a future "booster" water heater, if necessary. Even if backup equipment is ever installed, it is expected that most heating seasons will see zero electricity use, and if ever such a backup is used at all, the PVs will cover that usage. Meanwhile, without a backup, the home can maintain a comfortable indoor air temperature and provide adequate hot water using the solar collectors, storage tank, thermal mass, and passive gain." Update: installed water & heat electric "backups" in 1/07; have used ~300 kWh/winter for each, winters 2007 & 2008
- Electrical standby or "phantom" losses reduced where possible by power strips on switched outlets, and occupancy sensors (manual on/timed off) on applicable electrical appliances. 75-gal. fish tank removed 2/08, saving ~1600 kWh/year, enough to cover cooking and clothes drying, with extra to spare
- Low-energy major appliances, Energy Star-rated, and Energy Star low-water clothes washer
- Maximum allowed fly ash content in all concrete for foundations, slabs
- FSC-certified wall framing lumber (except plate material, which was not allowed to be the species then available in FSC); Roseburg I-joists for floors; engineered roof trusses

In the home's first year, we have enjoyed utility bills of \$5 to \$10 per month, and predict zero net annual energy costs. We also were awarded the first Xcel Amendment 37-related rebate & net metering refund in May 2006.

This is a showcase project, of course, but also is our family home. My wife Catherine and I have two children, 6 and 8, and plan on adopting another child several years from now. We have also designed for the contingency of elderly parents staying with us, as well as foreign exchange students, traveling activists, and visiting relatives and friends. The home has adequate space for meetings of all kinds -- for example political, parenting, personal growth, and neighborhood groups. We look forward to being a community resource in this sense during our time there. And with the home built to last several hundred years, the spaces and layout are adaptable to the wide variety of possible needs of future residents.

* On Thursday July 21, 2005 the city of Boulder's Chief Building Official approved the design for construction *without* electric or gas backup heating equipment. This may be a national first!