ZNEBA Finalist
Zer0 Net Energy Deep Energy Retrofit (ZNE / DER)
Fink-Simko Residence Melrose, MA
Owners: David Fink, Barbara Simko
Architect: Steve Baczek
Builder: Synergy Construction
Energy Consultants: DEAP, BSC, MassSave
Sponsor: National Grid, MassSave
Original Garrison Colonial House

- Built in 1945
- 1572 square feet area
- Wood and Aluminum Frame Windows
- Fiberglass Insulation in Attic Floor, Family Room
- Oil Fired Steam Heating System
- Gas Water Heater & Stove
- Fireplace in Basement and First Floor
ZNE / DER Strategy

- Transition to all electric house
- Super insulate per DER rules
- Focus on energy efficiency
- Optimize floor plan without adding floor area to lower cost
- Recover space occupied by obsolete systems
- Remove chimney and two fireplaces
- Move top thermal boundary from attic floor to roof
- Employ full envelope insulation and super tight air sealing
- Use high R value & high solar gain windows
- Utilize heat pump based heating/cooling equipment
- Ventilate and recover waste heat with efficient HRV
- Recover shower drain water waste heat with heat exchanger
- Use induction stove, efficient appliances, LED & CFL lights
- Use roof mounted high efficiency PV to reach ZNE
R-8 Triple Pane Windows
Kitchen Demolition
Window Frame Surgery
Chimney Removal
R-13 Polyiso Insulation for Outside Walls
Add Sister Joists for PV and Snow Loads
Heat Recovery Ventilator in Attic
Heat Pump Water Heater & GFX
Front Elevation (North)

Original
1945 Garrison Colonial
1572 ft²

Finished
Oct 2013 DER/ZNE
1572 ft²
Rear Elevation (South)

Original

Finished
Kitchen Relocated Over Garage
Enlarged Dining Room
Performance

- HERS Rating predicted with REM/Rate analysis during the design phase: -1

- For a 1 year time period starting on Jan 7th of 2014, actual performance exceeded zero net energy. Measured energy use was:
  - 9103 kWh produced by PV
  - 8395 kWh used in DER house (92.2% of PV Output)
  - 708 kWh net surplus to grid (7.8% of PV Output)

- Blower Door Final Results: 434 CFM @ 50 Pa, 1.43 ACH 50, 0.09 CFM /ft²
Mini Split Cold Weather Torture Testing
Roof Glacier Fall Test Results

Feb 15, 2015

March 4, 2015
Roof Glacier Deck Damage
Mini Split Outdoor Units OK Under Deck
Mini Split Indoor Unit Locations

Kitchen on 1st Floor

Hall on 2nd Floor
Mini Split Cold Weather Power Data

- Measure Combined Mini Split Power using TED 1001 Energy Monitor at Night when Window Solar Gain = 0
- Outside Temp = -4 degF
- Two Mini Splits Set in Heating Mode @ 68 degF
- Measured 2.8 kWh in 1 hour and 40 minutes
- Total Mini Split Avg Power = 2.8 kWh/1.667 h = 1.68 kW
- Kitchen Toaster Power = 950 W
- At -4 degF outside, less than two toaster’s worth of electrical power will keep house at 68 degF inside!
- At warmer more typical 24 degF outside, required electrical power is roughly cut in half!
Technology Summary

- PV: 7.35 kW SunPower E19/245 3 x 10 array with Enphase M210 microinverters
- Roof: R-60, 6” polyiso over sheathing + blown-in cellulose between rafters
- Walls: R-40, 4” polyiso over sheathing + blown-in cellulose in stud cavities
- Basement walls: R-23, 2” XPS + 2.0” polyiso + foam, R-4, 0.4” Spaceloft near stairs
- Basement floor: R-10, 2” XPS over existing concrete slab
- Windows: R-8, triple pane, Schuco SI82 U-PVC casements & slider, SHGC=0.4-0.6
- Doors: R-5 Therma-Tru on 1st Floor, Therma-Tru fire doors in basement
- Heating & Cooling: 2 Mitsubishi MUZ-FE09NA heat pumps, rated heating=2.0 kW, COP=3.0 @ 17°F out/70°F in, rated cooling=2.6 kW, COP=4.5 @ 80°F in/95°F out
- HRV: Zehnder CA-350, 87% efficiency, meas. flow 61/95/155 cfm, balanced flow
- Hot Water: GE GEH50DEEDSCA 50 gallon heat pump water heater with 2.4 EFR
- Drain Water Heat Recovery: GFX G4-40 with efficiency = 0.67 @ 1GPM / 1 GPM
Project Team

- Owners & Preliminary Designers: David Fink, Barbara Simko
- Architect: Steven Baczek
- Builder: Synergy (Gary Bergeron, Alex Cheimets, David Joyce, Brad King)
- Interior Designer: Barbara Simko
- PV Installer: New England Clean Energy (Mark Durrenberger, Jonathan Williams)
- Windows: European Architectural Supply (Patrik Muzila)
- Ventilation & HRV: Zehnder America (Barry Stephenson, Aubrey Gewehr)
- Energy Consultants: Building Science Corporation (Honorata Loomis), DEAP Energy Group (Mike Duclos, Paul Eldrenkamp), MassSave (Brian Tierney)
- DER Program Sponsor: National Grid (Dave Legg, Oliver Klein, Marie McMahon)
- Photography: MindinMotion(Victor Fink), Steve Baczek, David Fink
- Finance: MassSave Heat Loan (Ashley Sullivan), Eastern Bank (James Cobb)
Thank You