Making the Leap
Large Scale Passive House

PHCa Spring Symposium March 20, 2013

Graham Irwin, principal
Essential Habitat
EH Passive House Projects

O’Neill Residence, Sonoma, CA (2010)
1st Certified Passive House in CA
1st Certified PH Retrofit in US

Wood Residence, Sonoma, CA (2012)
PH Residence & Guest House

Singh-Hee Residence, Atherton, CA (2012)
PH Residence & Guest House

Field-Chiariello Res., Portola Valley, CA (2011)
Passive House Retrofit

Midori Haus, Santa Cruz, CA (2012)
NZE Passive House Retrofit

Moe Residence, Shaver Lake, CA (2013)
NZE Passive House Custom Home

Green Gulch Farm Zen Center
Muir Beach, CA (2011)
Passive House Dormitory

Kaplan/Malarkey Residence
San Francisco, CA (2013)
NZE Passive House Retrofit

ENU Passive House
San Francisco, CA (2013)
NZE Passive House Spec. Home

Blachford Residence, Healdsburg, CA (2013)
NZE Home
EH Passive House Projects

John Trigg Library, Ester, AK (2013)
PH Library

Rawlings Residence, Castle Rock, CO (2013)
NZE Custom Home

New Town Builders Denver, CO (2013)
NZE Production Homes

Volks House, Santa Fe, NM (2012)
NZE Passive House Spec. Home
# PH Project Implementation

## Single vs Multi-Family / Multi-Unit

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Single Family</th>
<th>Multi-Family</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment Savings Potential</td>
<td>Small to None</td>
<td>Good to Excellent</td>
</tr>
<tr>
<td>Financial Analysis</td>
<td>Simple Payback &amp; 1\textsuperscript{st} Cost</td>
<td>Lifecycle Cost</td>
</tr>
<tr>
<td>Floor to Shell Area Ratio</td>
<td>Sub-Optimal to OK</td>
<td>Good to Excellent</td>
</tr>
<tr>
<td>Incremental Costs (EU)</td>
<td>5-8% SF</td>
<td>0% MF</td>
</tr>
<tr>
<td>Project Approval</td>
<td>Homeowner</td>
<td>Larger Entity</td>
</tr>
</tbody>
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Single Family is the Hardest Case to Make!
Multi-Family Case Study
21 Units Affordable Housing
Whittier, CA

Climate Zone 9 Prescriptive Requirements
Ceiling (R30): 7.5”
Walls (R13): 2x4
Slab (R0): No Insulation
Glazing U-Value: 0.40
Glazing SHGC: 0.4 (Max)
Maximum Glazing: 20%, 5% West (Max)
Shell Leakage: None, Assumed 6 ACH₅₀
Multi-Family Case Study
Cost Optimized Upgrades

Heating & Cooling Demand

- Attic Insulation
- Wall Cavity Insulation
- Floor Cavity Insulation
- Top of Slab Insulation
- Exterior Door U-Value
- Roof Absorptivity
- Window U Value
- Window SHGC
- Window SHGC (South Only)
- Orientation
- Air Tightness
- Heat Recovery
- Thermal Mass
Multi-Family Case Study
Effective Improvements

Cumulative Improvement

- Heating Demand
- Heating Load
- Cooling Demand
- Cooling Load

Step 1: Air Tightness
Step 2: Heat Recovery Ventilation
Step 3: 2x6 Wall Insulation
Step 4: Cool Roof
Step 5: Energy Star Glazing
Step 6: Exterior Shades
## Multi-Family Case Study Results

<table>
<thead>
<tr>
<th>PERFORMANCE METRIC</th>
<th>CODE MINIMUM</th>
<th>PASSIVE HOUSE</th>
<th>REDUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Heating</td>
<td>56,259 kWh/yr</td>
<td>25,137 kWh/yr</td>
<td>55%</td>
</tr>
<tr>
<td>Annual Cooling</td>
<td>16,938 kWh/yr</td>
<td>9,693 kWh/yr</td>
<td>43%</td>
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<tr>
<td>Heating Load</td>
<td>34,775 W</td>
<td>14,378 W</td>
<td>59%</td>
</tr>
<tr>
<td>Cooling Load</td>
<td>26,641 W</td>
<td>18,685 W</td>
<td>30%</td>
</tr>
</tbody>
</table>

### Mechanical Savings
Central Heat & Ventilation (49,000 BTU/hr Total) vs 21 Gas Furnaces