Getting to Passive House in Vermont

Peter Schneider, Vermont Energy Investment Corporation
Habitat for Humanity, Charlotte, VT

Green Mountain Habitat for Humanity
Albert, Righter & Tittmann Architects, Inc.
Peter Schneider, Vermont Energy Investment Corp.
Eric Morrow, 22 Collaborative
Preferred Building Systems, Claremont, NH
UltimateAir, Akron, OH
Go Sunward, Vergennes, VT
Moving Towards Simplicity

GETTING TO PASSIVE HOUSE in VERMONT
Vermont Energy Investment Corporation
Passive House Energy Standard

Heating Load (Site): 4.75 kBTU/SF/YR
Cooling Load (Site): 4.75 kBTU/SF/YR
Total Energy Demand (Source): 38 kBTU/SF/YR
Air Tightness: .6 ACH @ 50pa
Passive House Concept
Controlling Heat Loss… INSULATION

R58 WALLS: R130 CEILING: R60 SLAB
High Performance WINDOWS U value 0.18

GETTING TO PASSIVE HOUSE in VERMONT
Vermont Energy Investment Corporation
Passive House Concept

Controlling Heat Loss... ELIMINATE THERMAL BRIDGES

GETTING TO PASSIVE HOUSE in VERMONT
Vermont Energy Investment Corporation
Passive House Concept

Controlling Heat Loss… REDUCE AIR INfiltrATION

.6 ACH @ 50 PA

GETTING TO PASSIVE HOUSE in VERMONT

Vermont Energy Investment Corporation
Passive House Concept
Capturing Heat Gains… PEOPLE

GETTING TO PASSIVE HOUSE in VERMONT
Vermont Energy Investment Corporation
Passive House Concept
Capturing Heat Gains… EQUIPMENT

GETTING TO PASSIVE HOUSE in VERMONT
Vermont Energy Investment Corporation
Passive House Concept
Capturing Heat Gains… SOLAR ENERGY

GETTING TO PASSIVE HOUSE in VERMONT
Vermont Energy Investment Corporation
Passive House Concept

Controlling Gains Seasonally… WINDOWS AND ORIENTATION

U VALUE .10: TRIPLE GLAZED: >.5 SHGC ON SOUTH WINDOWS

GETTING TO PASSIVE HOUSE in VERMONT

Vermont Energy Investment Corporation
Passive House Concept
Providing Fresh Air… HEAT RECOVERY VENTILATION

MINIMUM .35 ACH

GETTING TO PASSIVE HOUSE in VERMONT
Vermont Energy Investment Corporation
Passive House Concept

GETTING TO PASSIVE HOUSE in VERMONT

Vermont Energy Investment Corporation
Passive House Results

- 90% reduction in heating and cooling loads when compared to Code
- 70%-80% reduction in total energy demand
- Superior indoor air quality
- Occupant comfort
- Lower annual energy costs
- Smaller carbon footprint
A Tale of Two Houses
Same plan, Same site, Different results

Cape

Passive House

GETTING TO PASSIVE HOUSE in VERMONT
Vermont Energy Investment Corporation
Initial Cape Design

GETTING TO PASSIVE HOUSE in VERMONT
Vermont Energy Investment Corporation
Preliminary Passive House Sketches

GETTING TO PASSIVE HOUSE in VERMONT
Vermont Energy Investment Corporation
Preliminary Passive House Sketches

GETTING TO PASSIVE HOUSE in VERMONT

Vermont Energy Investment Corporation
Habitat for Humanity Passive House

GETTING TO PASSIVE HOUSE in VERMONT
Vermont Energy Investment Corporation
GETTING TO PASSIVE HOUSE in VERMONT

Vermont Energy Investment Corporation
Habitat Passive House – 2nd Floor

GETTING TO PASSIVE HOUSE in VERMONT
Vermont Energy Investment Corporation
Habitat for Humanity Passive House

GETTING TO PASSIVE HOUSE in VERMONT
Vermont Energy Investment Corporation
Habitat for Humanity Passive House

GETTING TO PASSIVE HOUSE in VERMONT
Vermont Energy Investment Corporation
Habitat Passive House – Section

GETTING TO PASSIVE HOUSE in VERMONT
Vermont Energy Investment Corporation
Habitat for Humanity Passive House
Footing Detail

GETTING TO PASSIVE HOUSE in VERMONT
Vermont Energy Investment Corporation
Habitat for Humanity Passive House
Sill Detail

GETTING TO PASSIVE HOUSE in VERMONT
Vermont Energy Investment Corporation
Habitat for Humanity Passive House
Wall Section

GETTING TO PASSIVE HOUSE in VERMONT
Vermont Energy Investment Corporation
Habitat for Humanity Passive House
Second Floor Platform Detail

GETTING TO PASSIVE HOUSE in VERMONT
Vermont Energy Investment Corporation
Habitat for Humanity Passive House
Eave Detail

GETTING TO PASSIVE HOUSE in VERMONT
Vermont Energy Investment Corporation
Habitat for Humanity Passive House
Windows

Serious Materials
925 Series

.47 SHGC

Glazing U-value .107
Frame U-value .17

GETTING TO PASSIVE HOUSE in VERMONT
Vermont Energy Investment Corporation
Habitat for Humanity Passive House
HVAC System

Air Source Heat Pump:
Mitsubishi Hyper-heat MSZ-MUZ FE 09

ERV:
UltimateAir Recouperator ERV

Soil heat exchange system:
Two 125' loops of 1" pex around the base of the footings filled with water/glycol mix & tied to Laing 30W AC Pump & water-to-air coil made by UltimateAir (~40F Temp Rise)

Solar Hot Water:
Sunward Solar water heating system mounted on roof with 40g electric hot water heater as back-up
How much energy is used in houses?

GETTING TO PASSIVE HOUSE in VERMONT

Vermont Energy Investment Corporation
Comparison of Annual Heating Costs

GETTING TO PASSIVE HOUSE in VERMONT
Vermont Energy Investment Corporation
## Comparison of Total Costs

<table>
<thead>
<tr>
<th></th>
<th>Energy Code Home</th>
<th>Passive House</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Cost of Home (Includes $200k for Land and Site Work)</td>
<td>$324,417</td>
<td>$364,925</td>
</tr>
<tr>
<td>Mortgage/month 30 year fixed @ 5%</td>
<td>$1,742</td>
<td>$1,959</td>
</tr>
<tr>
<td>Insurance</td>
<td>$35</td>
<td>$35</td>
</tr>
<tr>
<td>Property Taxes</td>
<td>$500</td>
<td>$500</td>
</tr>
<tr>
<td>Estimated monthly energy costs @ $3/gal; elec $.14/kWh</td>
<td>$333</td>
<td>$52</td>
</tr>
<tr>
<td><strong>Total Costs/month @ $3/gal; elec $.14/kWh</strong></td>
<td><strong>$2,610</strong></td>
<td><strong>$2,546</strong></td>
</tr>
<tr>
<td>Estimated monthly energy costs @ $5/gal; elec $.20/kWh</td>
<td>$583</td>
<td>$73</td>
</tr>
<tr>
<td><strong>Total Costs/month @ $5/gal; elec $.20/kWh</strong></td>
<td><strong>$2,860</strong></td>
<td><strong>$2,567</strong></td>
</tr>
</tbody>
</table>

Passive House yearly savings @ $3/gal; elec $.14/kWh over energy code home = $768

Passive House yearly savings @ $5/gal; elec $.20/kWh over energy code home = $3,509

**GETTING TO PASSIVE HOUSE in VERMONT**

Vermont Energy Investment Corporation