MEASURING ENERGY COST AGAINST BUILD COST ON TWO PASSIVE HOUSE PROJECTS
TBDA/EHB JOINT PASSIVE HOUSE WORK TO DATE
CASE STUDY PROJECTS

Case 1: Oak Park
Certified PHIUS+ 2015
Slab-on-grade
1,724 s.f. iCFA

Case 2: Hinsdale
Pre-Certified PHIUS+ 2015
Full basement
2,348 s.f. iCFA
Case 1: Oak Park
Walls: 2x8/BIB/Plywd+Prosoco, 4” polyiso, R-50
Slab: 4” concrete, 6” EPS, R-27
Roof: 14”TJI/BIB/Plywod+Prosoco, 5” polyiso, R-83
Zola Thermo uPVC, Uw=0.147
HVAC: Zehnder/Mitsubishi, internal circulation

Case 2: Hinsdale
Walls: 2x6/cell./Zip shthg., 5.25” EPS, R-43
Slab: 4” concrete, 5” EPS, R-21
Roof: 24” cellulose, vented attic, R-85
Zola Thermo uPVC, Uw=0.145
HVAC: CERV/Mitsubishi(s), transfer grilles
Case 1: R-50 wall
2X8 wall
Prosoco air barrier o/ bucks
4" Polyiso
WRB
Furring strips + Cladding

Case 2: R-43 wall
2X6 wall
Zip sheathing (air barrier) w/ Prosoco over bucks
5.25" EPS
WRB
Furring strips + Cladding

New almost-passive case: R-31
2X6 wall
Zip sheathing (air barrier) w/ Zip tape at joints
2.5" Insofast EPS
Cladding

Note: code-built wall assembly not drawn.
“Insofast” option includes the following savings:
• 2X6 wall (vs. 2X8 at Case 1)
• 1/2” Zip sheathing (vs. 5/8” plywood at Case 1)
• 2.5” Insofast (modeled) or 3” EPS (priced)
• Same roof and slab
• Foundation at Case 2: 4.5” EPS (vs. 10” at Passive)
• Same HVAC
• Same windows

Total savings:
• Case 1: $16,432
• Case 2: $7,210

Code-built option included these changes:
• 2X6 wall w/R-21 hi-density batts
• No exterior insulation
• Roof:
  • Case 1: 16” TJI/BIBs, no exterior insulation
  • Case 2: R-50 blown cellulose
• Foundation:
  • Case 1: same as Passive (frost-protected)
  • Case 2: dampproofing, 2” XPS
• Slab:
  • Case 1: same as Passive
  • Case 2: 1” XPS
  • Windows: Jeldwen U=0.3, SHGC=0.21
• HVAC: 96% gas, 13 SEER AC, gas DHW*, exhaust-only vent.

Total savings:
• Case 1: $42,518
• Case 2: $28,106

(Note—HVAC more expensive on Case 1 code-built!)
YEARLY ENERGY COMPARISON

Case 1: Base Case 13% incr. 150% incr.
Case 2: Base Case 8.5% incr. 152% incr.

Total energy comparison: Base Case Space condit. comparison: Base Case

Evolutionary Home Builders by Brandon Weiss

TOTAL ENERGY (KWH/A)

Total
9263.71
10478.28
23136.28

Misc. Energy (kWh/a)
4420.40
4420.40
5064.70

Ventilation (kWh/a)
379.00
389.30
-

Total Cooling Demand (kWh/a)
2467.47
2384.49
1830.24

Total Heating Demand (kWh/a)
1996.84
3284.09
16241.34

Total energy comparison: Base Case 13% incr. 150% incr.

Evolutionary Home Builders by Brandon Weiss

SITE ENERGY (KWH/A)

Yearly Energy Comparison

Case 1:

Case 2:

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COST OF OWNERSHIP COMPARISON

Using:
- $0.13/kw electricity cost, all houses all electric
- 4% interest on 30-yr mortgage
- No increase on energy cost included

<table>
<thead>
<tr>
<th></th>
<th>PASSIVE</th>
<th>INSOFAST</th>
<th>CODE-BUILT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Cost (per year)</td>
<td>$1204.28</td>
<td>$1362.18</td>
<td>$3007.72</td>
</tr>
<tr>
<td>Yearly Mortgage Cost</td>
<td>$34368.00</td>
<td>$33432.00</td>
<td>$31944.00</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>$35,572</td>
<td>$34,794</td>
<td>$34,952</td>
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</tbody>
</table>

**YEARLY COST**

Case 1:

Case 2:
SOME TAKE-AWAYS & QUESTIONS

1. Cost of ownership is a wash! Better to invest in house instead of pay more for energy, an uncertain cost over time.

2. But--getting more money on a loan from a bank can be a sticking point: enlightened appraisal needed.

3. The more efficient our heating devices, the less impact insulation will have on overall energy (comfort and durability still major considerations though).

4. We’re close to a “sweet spot” for ideal thermal envelope investment, but the “Insofast” route looks sweeter.

5. Cooling demand is lower on less insulated envelopes in our climate.

6. Should NZE have a place at the table when site conditions allow? (see next slides…)}
### National Average Source Energy Conversion Factors

<table>
<thead>
<tr>
<th>Energy Form</th>
<th>Source Energy Conversion Factor (r)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imported Electricity</td>
<td>3.15</td>
</tr>
<tr>
<td>Exported Renewable Electricity</td>
<td>3.15</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>1.09</td>
</tr>
<tr>
<td>Fuel Oil (1,2,4,5,6,Diesel, Kerosene)</td>
<td>1.19</td>
</tr>
<tr>
<td>Propane &amp; Liquid Propane</td>
<td>1.15</td>
</tr>
<tr>
<td>Steam</td>
<td>1.45</td>
</tr>
<tr>
<td>Hot Water</td>
<td>1.35</td>
</tr>
<tr>
<td>Chilled Water</td>
<td>1.04</td>
</tr>
<tr>
<td>Coal or Other</td>
<td>1.05</td>
</tr>
</tbody>
</table>

**PV IN PHIUS+2015**

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### PHIUS+ 2015 Calculators

*Results in green*

<table>
<thead>
<tr>
<th>Calculation</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(CFA) ft²</td>
<td>1290.3</td>
</tr>
<tr>
<td># bedrooms</td>
<td>3</td>
</tr>
<tr>
<td>Total envelope area (ft²)</td>
<td>5320</td>
</tr>
<tr>
<td>Net Volume for press. test (ft³)</td>
<td>16322</td>
</tr>
</tbody>
</table>

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### Primary Energy

<table>
<thead>
<tr>
<th>Calculation</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Energy Target (kBTU/ft² yr)</td>
<td>65.58</td>
</tr>
</tbody>
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### Air-tightness

<table>
<thead>
<tr>
<th>Calculation</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Air-tightness allowance (ACH50)</td>
<td>0.98</td>
</tr>
</tbody>
</table>

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### Lighting & Plug Loads

<table>
<thead>
<tr>
<th>Calculation</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Televisions + Misc. Elec. Loads (kWh/yr)</td>
<td>1435</td>
</tr>
<tr>
<td>Interior lighting (kWh/yr)</td>
<td>495</td>
</tr>
<tr>
<td>Exterior Lighting (kWh/yr)</td>
<td>33</td>
</tr>
<tr>
<td>Garage Lighting (if present) (kWh/yr)</td>
<td>20</td>
</tr>
</tbody>
</table>

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### PV Utilization

<table>
<thead>
<tr>
<th>Calculation</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site electricity (kWh/yr)</td>
<td>3879</td>
</tr>
<tr>
<td>Output from PV Watts (kWh/yr)</td>
<td>2526</td>
</tr>
<tr>
<td>Annual PV Output/Annual Electricity Demand</td>
<td>0.65</td>
</tr>
<tr>
<td>Utilization fraction from utilization curve</td>
<td>0.5</td>
</tr>
<tr>
<td>Primary Energy offset by PV (kBTU/ft² yr)</td>
<td>10.55</td>
</tr>
</tbody>
</table>
## COST TO NZE COMPARISON USING DOE DEFINITION

<table>
<thead>
<tr>
<th>NET ZERO CONSTRUCTION COST</th>
<th>PASSIVE</th>
<th>INSOFAST</th>
<th>CODE-BUILT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$624,200.00</td>
<td>$608,768.00</td>
<td>$659,482.00</td>
<td></td>
</tr>
</tbody>
</table>

Using:
- $4,000/kW installed (too high?)
- 345W per panel

### Using:

- 6.05kW array, 18 panels
- 6.30kW array, 18 panels
- 25.5kW array, 74 panels
- 8.25kW array, 24 panels
- 8.5 kW array, 25 panels
- 83 kW array, 83 panels
NZE COMPARISON

These illustrate the difference between array size for Passive vs. code-built.

If you’re thinking NZE, you have to think about your roof area!
QUESTIONS/COMMENTS/RUDE GESTURES

THANKS.

THIS PRESENTATION WILL BE POSTED ON TBDA BLOG,
WWW.DRAWINGONPLACE.COM/JOURNAL