

MEASURING ENERGY COST AGAINST BUILD COST ON TWO PASSIVE HOUSE PROJECTS



TOM BASSETT-DILLEY ARCHITECT
301 HARRISON STREET OAK PARK ILLINOIS 60304



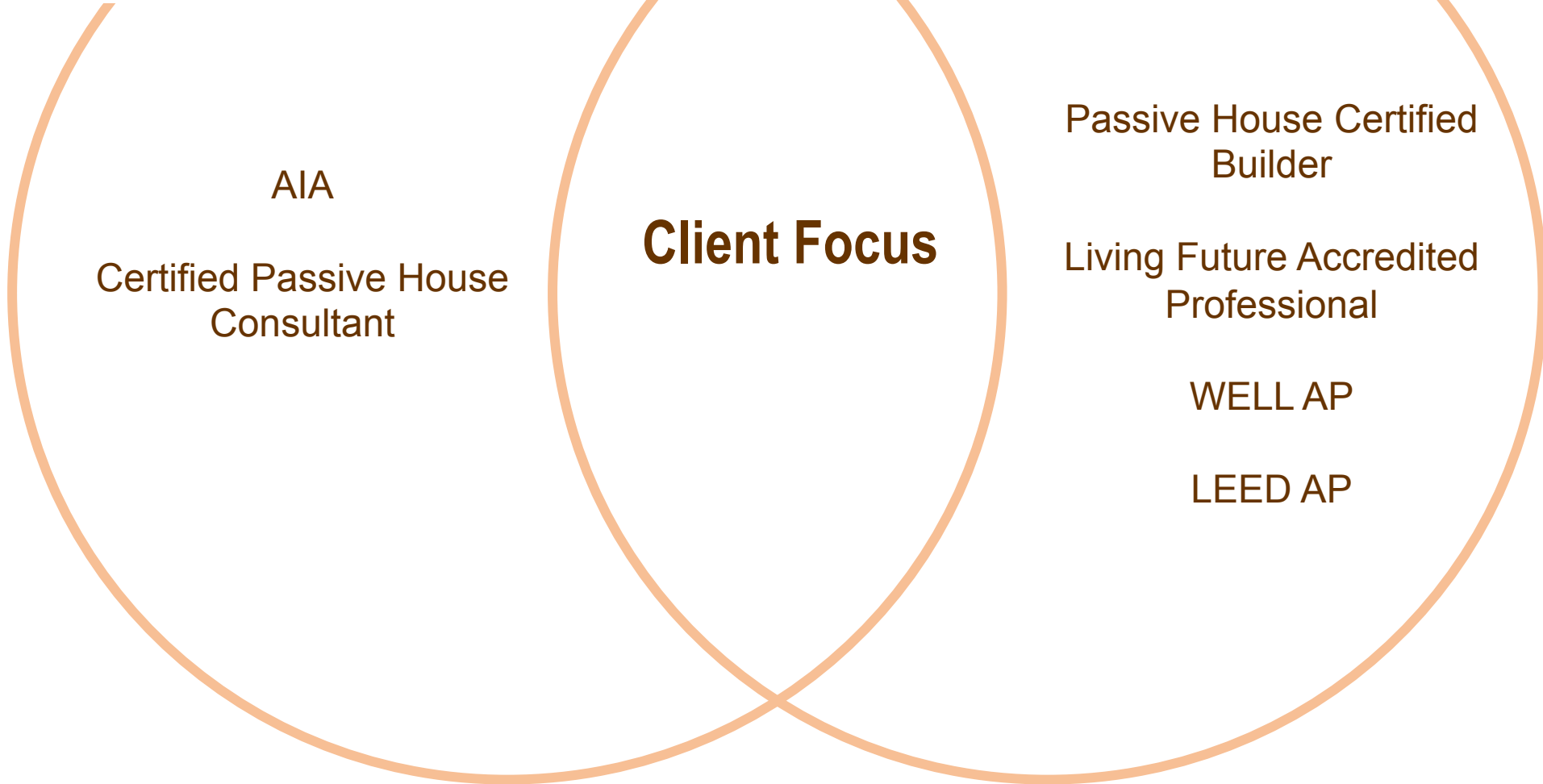
Evolutionary Home Builders
BY BRANDON WEISS



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AIA

Certified Passive House
Consultant

Client Focus

Passive House Certified
Builder

Living Future Accredited
Professional

WELL AP

LEED AP

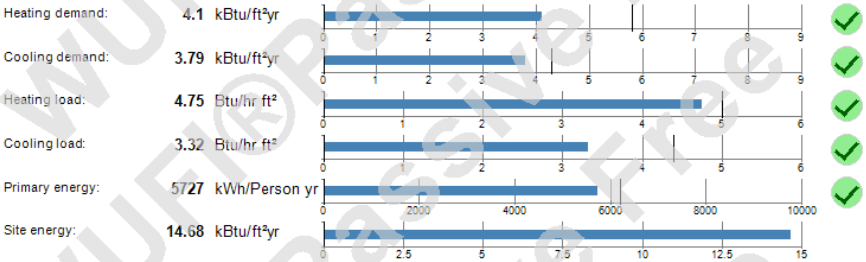
TBDA/EHB JOINT PASSIVE HOUSE WORK TO DATE



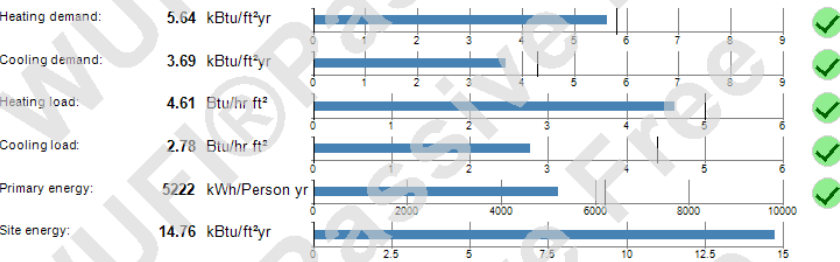
CASE STUDY PROJECTS



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



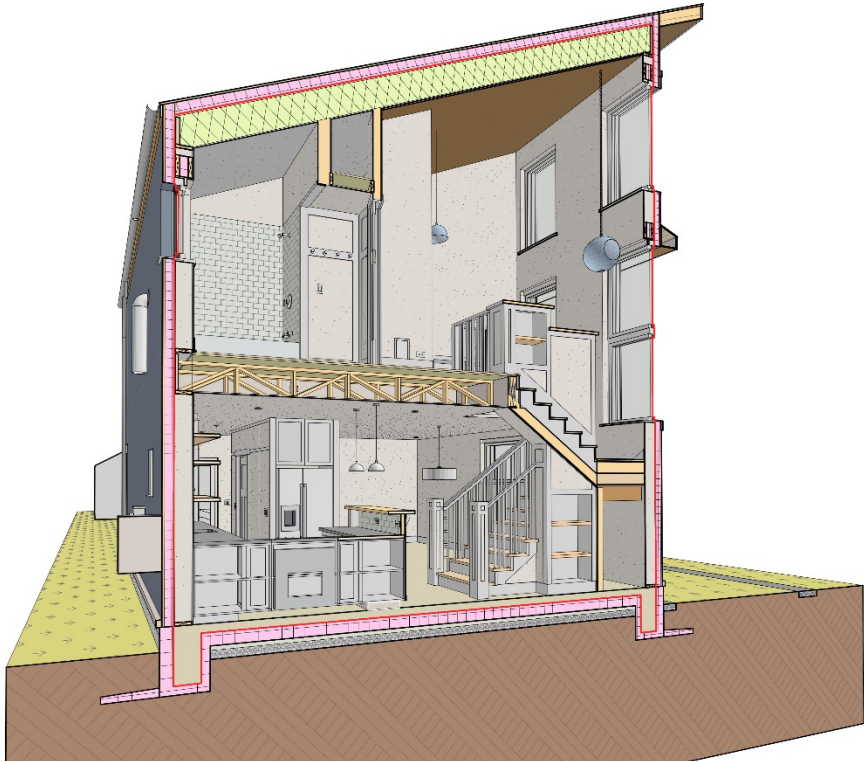
Case 2: Hinsdale
 Pre-Certified PHIUS+ 2015
 Full basement
 2,348 s.f. iCFA



Case 1:

CASE STUDY PROJECTS

Case 2:



Case 1: Oak Park

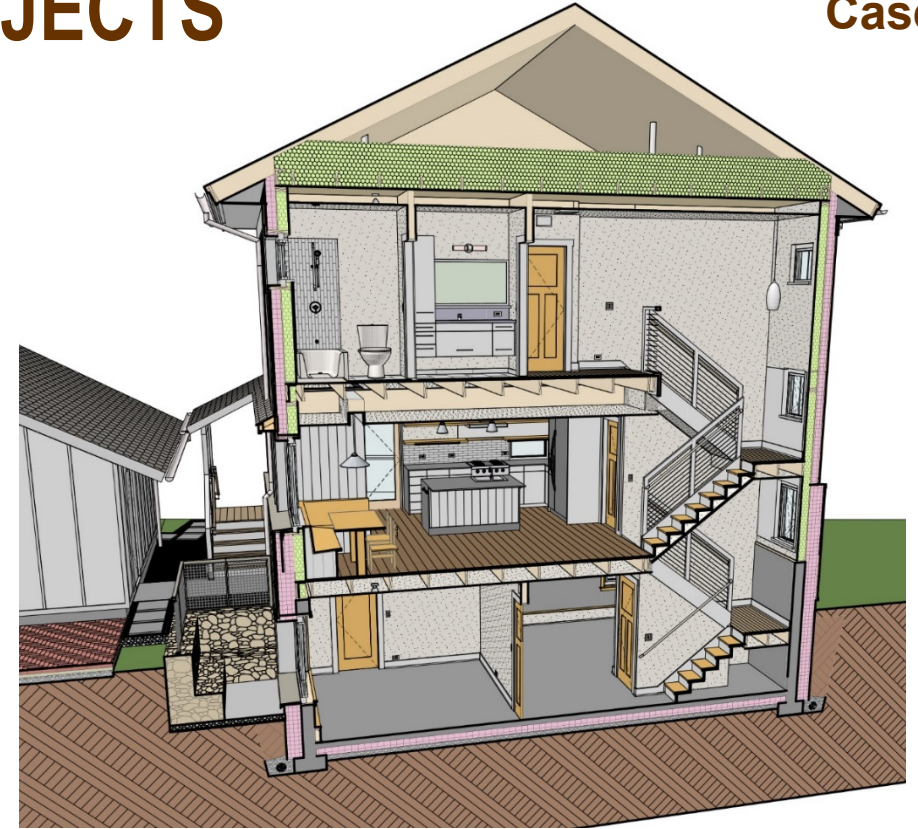
Walls: 2x8/BIB/Plywd+Prosoco, 4" polyiso, R-50

Slab: 4" concrete, 6" EPS, R-27

Roof: 14" TJI/BIB/Plywod+Prosoco, 5" polyiso, R-83

Zola Thermo uPVC, $U_w=0.147$

HVAC: Zehnder/Mitsubishi, internal circulation



Case 2: Hinsdale

Walls: 2x6/cell./Zip shthg., 5.25" EPS, R-43

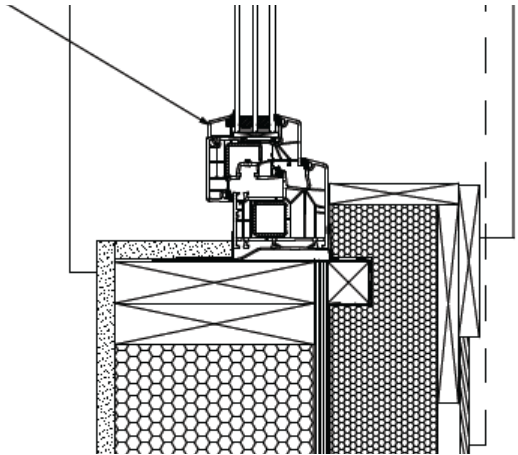
Slab: 4" concrete, 5" EPS, R-21

Roof: 24" cellulose, vented attic, R-85

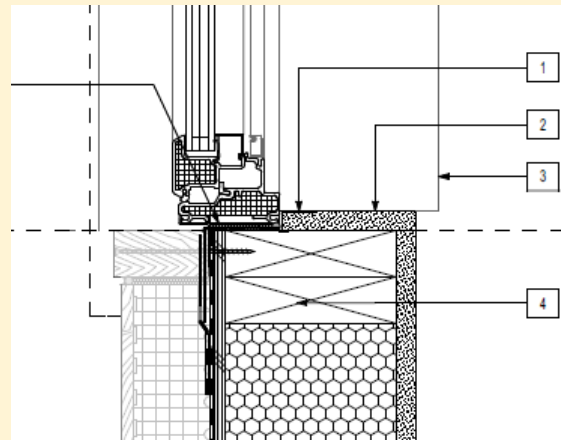
Zola Thermo uPVC, $U_w=0.145$

HVAC: CERV/Mitsubishi(s), transfer grilles

WALL SYSTEM COMPARISON

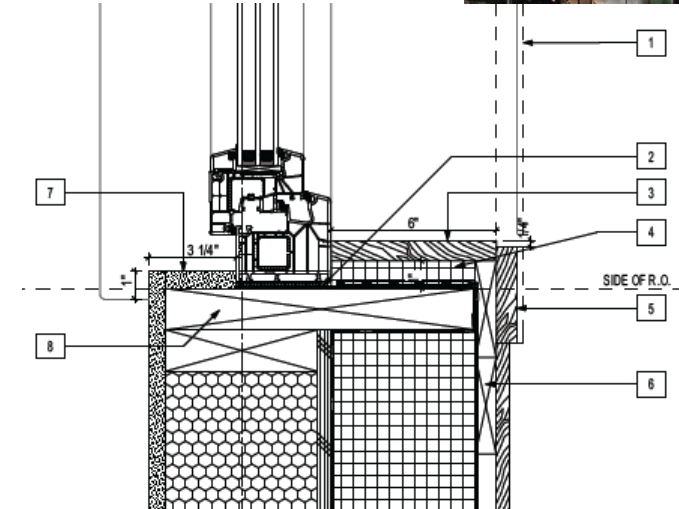


Case 1: R-50 wall
 2X8 wall
 Prosoco air barrier o/ bucks
 4" Polyiso
 WRB
 Furring strips + Cladding



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.



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

COST TO BUILD COMPARISON

[Passive House (built) condition is Base condition]

“**Insofast**” option includes the following savings:

- 2X6 wall (vs. 2X8 at Case 1)
- ½” 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:

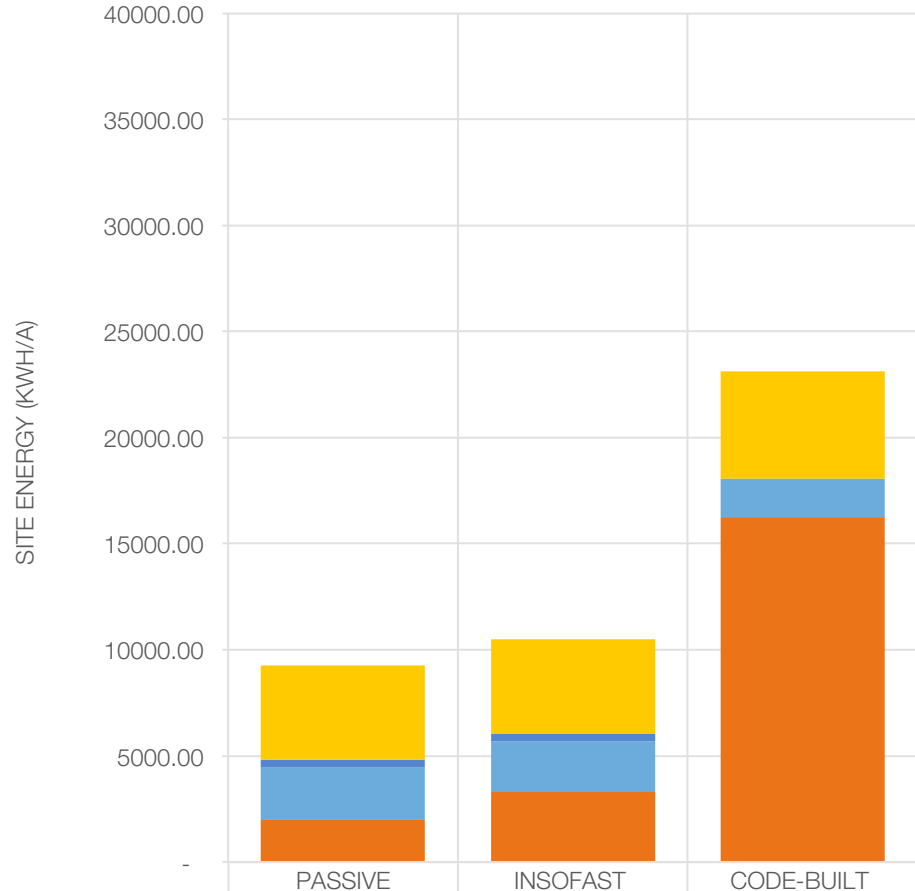
- Case 1: \$42,518
- Case 2: \$28,106

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

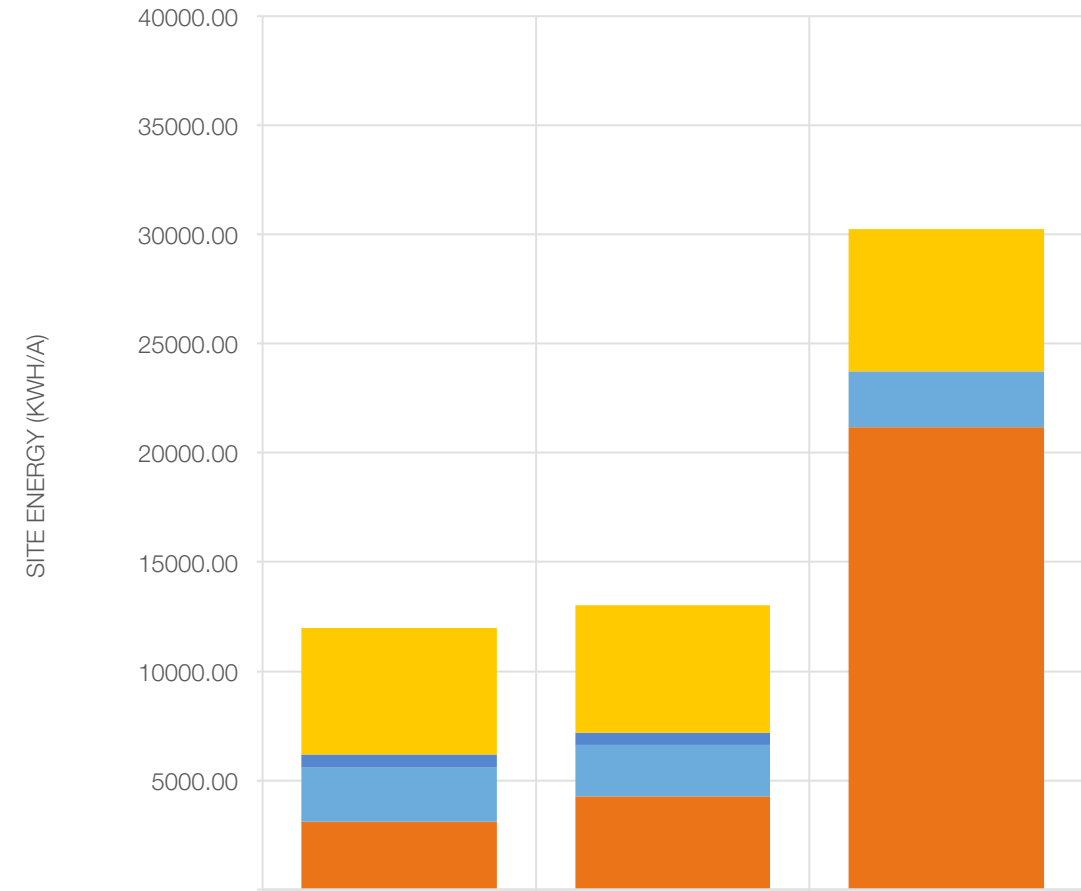
YEARLY ENERGY COMPARISON

Case 1:

Case 2:



	PASSIVE	INSOFAST	CODE-BUILT
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



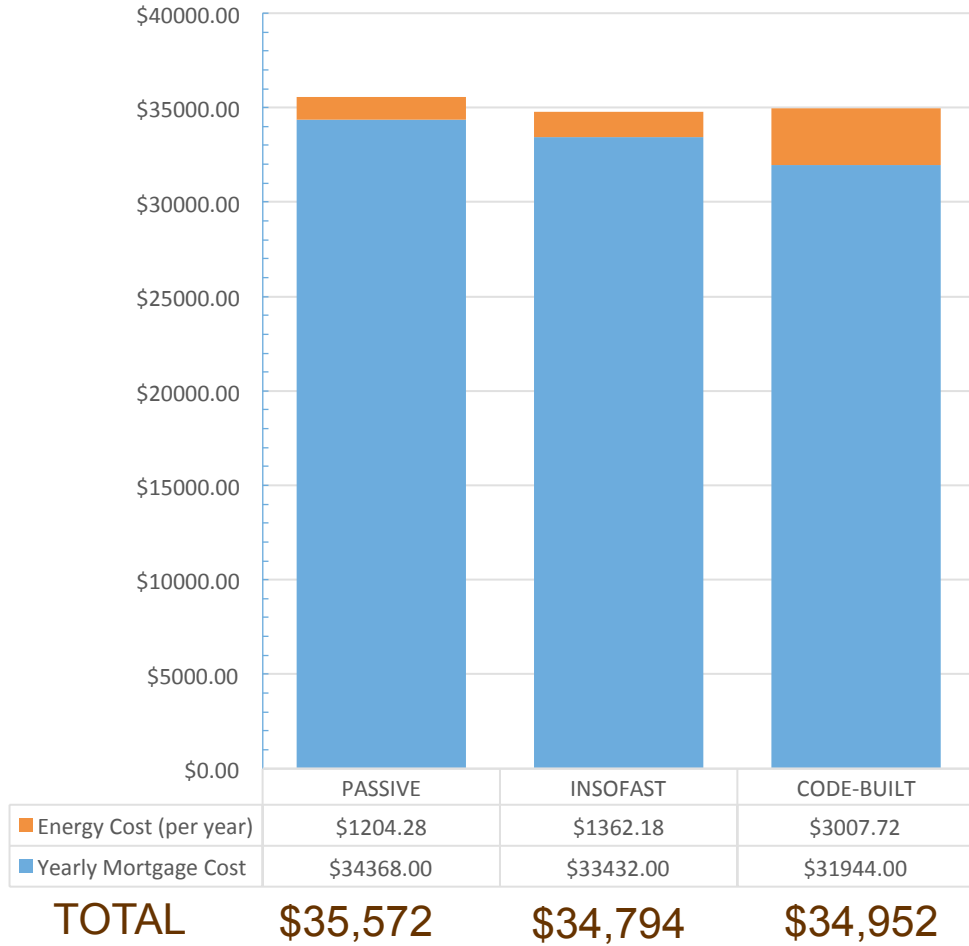
	PASSIVE	INSOFAST	CODE-BUILT
Total	11979.93	13006.35	30243.58
Misc. Energy (kWh/a)	5808.00	5808.00	6507.50
Ventilation (kWh/a)	571.50	571.50	-
Total Cooling Demand (kWh/a)	2508.41	2364.71	2551.24
Total Heating Demand (kWh/a)	3092.02	4262.14	21184.84

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

Total energy comparison: Base Case 8.5% incr. 152% incr.
Space condit. comparison: Base Case 18% incr. 323% incr.

COST OF OWNERSHIP COMPARISON

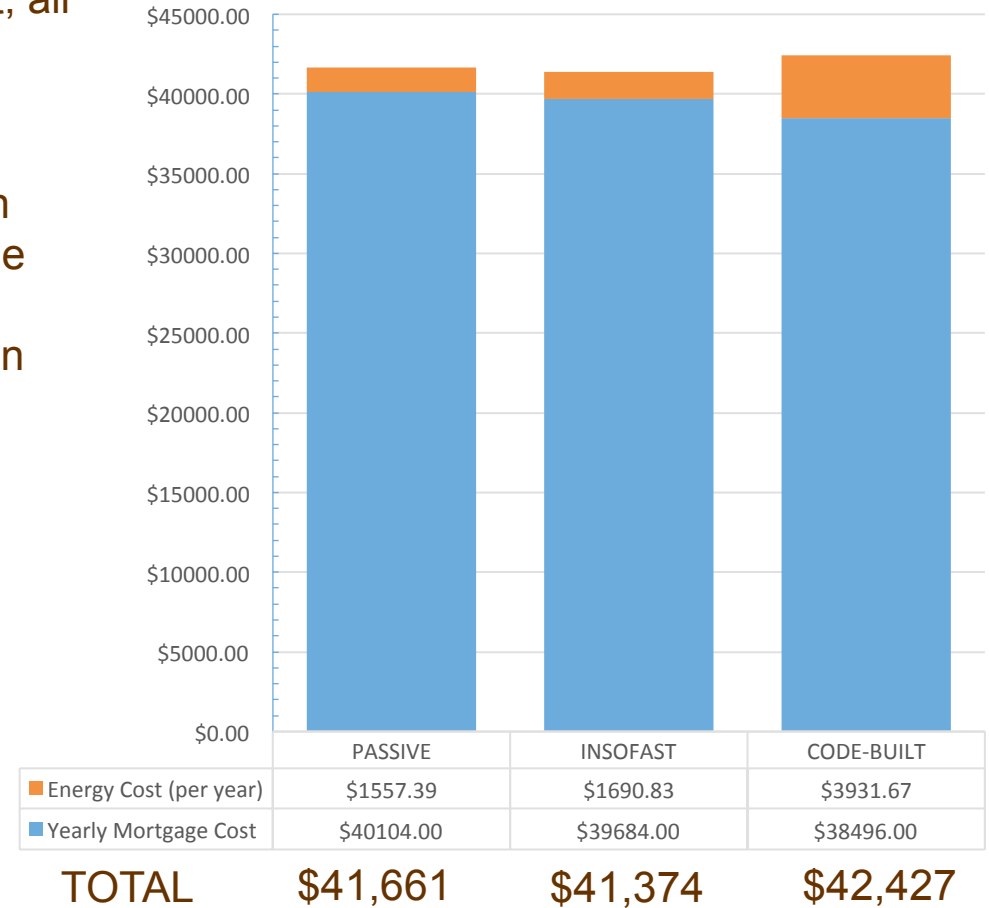
YEARLY COST



Using:

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

YEARLY COST



SOME TAKE-AWAYS & QUESTIONS

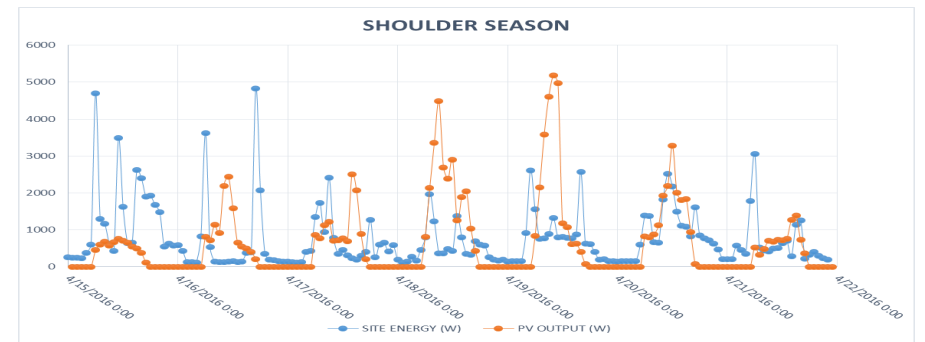
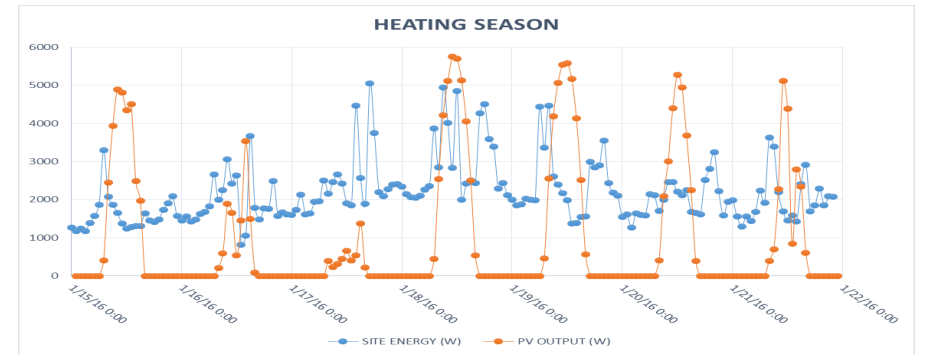
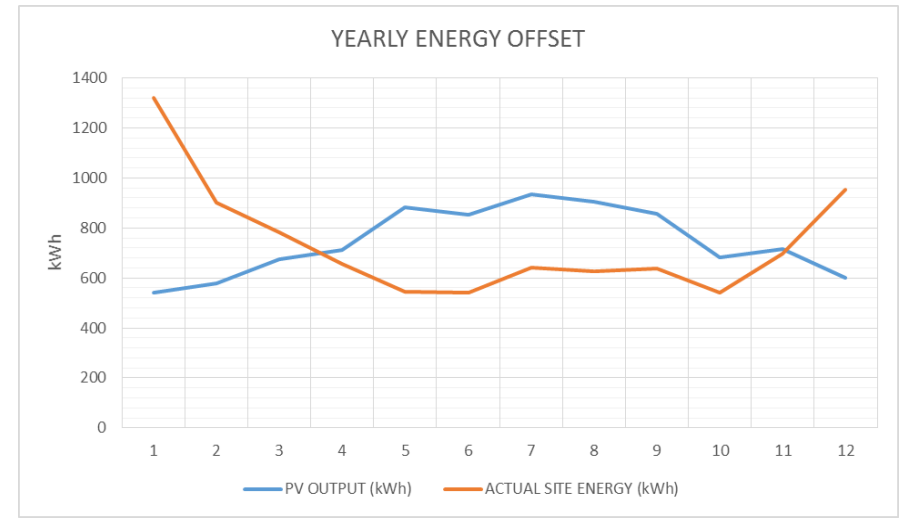
1. Cost of ownership is a wash! Better to invest in house instead of pay more for energy, an uncertain cost over time.
2. But--getting more money on a loan from a bank can be a sticking point: enlightened appraisal needed.
3. The more efficient our heating devices, the less impact insulation will have 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...)

NZE DEFINITIONS

Table 1 - National Average Source Energy Conversion Factors

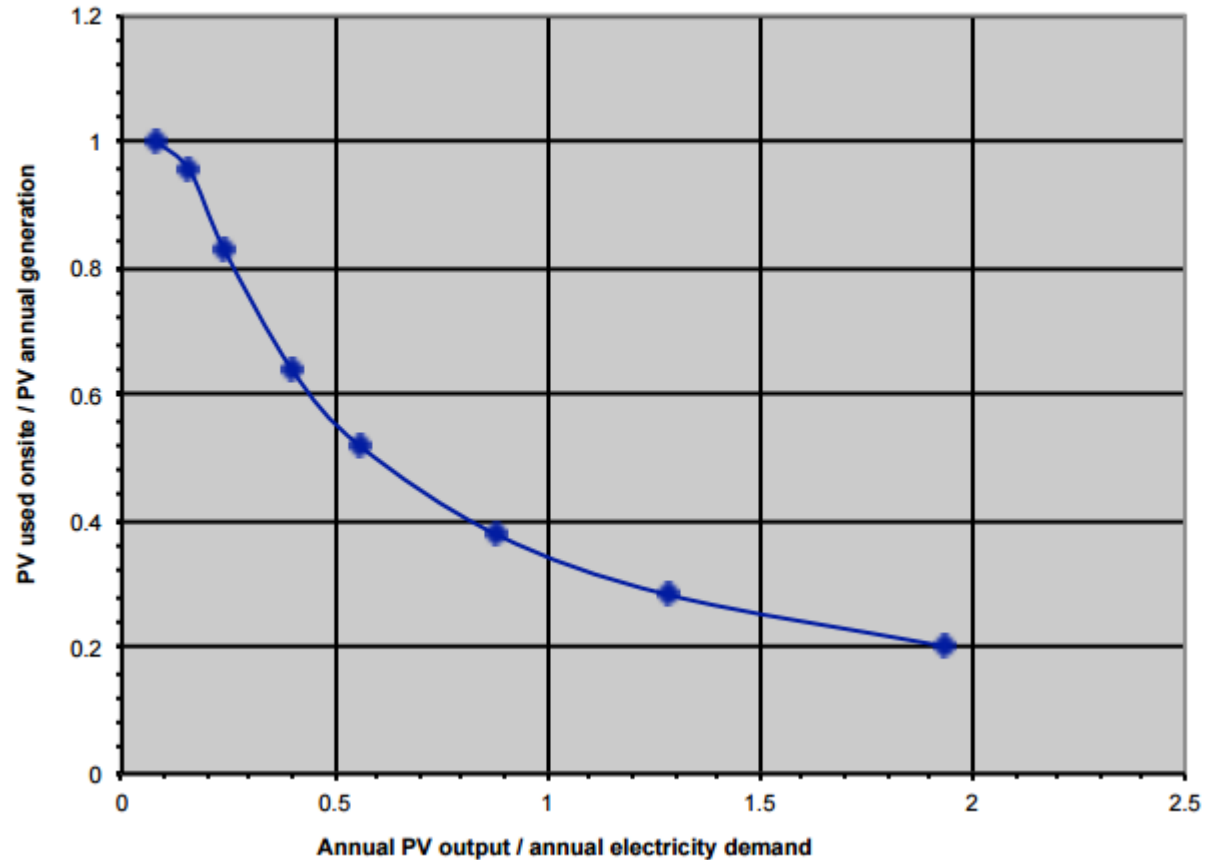
Energy Form	Source Energy Conversion Factor (r)
Imported Electricity	3.15
Exported Renewable Electricity	3.15
Natural Gas	1.09
Fuel Oil (1,2,4,5,6,Diesel, Kerosene)	1.19
Propane & Liquid Propane	1.15
Steam	1.45
Hot Water	1.35
Chilled Water	1.04
Coal or Other	1.05

DOE conversion factors http://energy.gov/sites/prod/files/2015/09/f26/bto_common_definition_zero_energy_buildings_093015.pdf



PV IN PHIUS+2015

PV onsite utilization, Zone 5A



PHIUS+ 2015 Calculators	
*Results in green	
iCFA (ft2)	1290.3
# bedrooms	3
Total envelope area (ft2)	5320
Net Volume for press. test (ft3)	16322

Primary Energy	
Primary Energy Target (kBtu/ft2.yr)	65.58

Air-tightness	
Air-tightness allowance (ACH50)	0.98

Lighting & Plug Loads	
Televisions + Misc. Elec. Loads (kWh/yr)	1435

Interior lighting (kWh/yr)	100%	495
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Exterior Lighting (kWh/yr)	100%	33
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Garage Lighting (if present) (kWh/yr)	100%	20
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PV Utilization	
Site electricity (kWh/yr)	3879
Output from PV Watts (kWh/yr)	2526
Annual PV Output/Annual Electricity Demand	0.65
Utilization fraction from utilization curve	0.5
Primary Energy offset by PV (kBtu/ft2.yr)	10.55

COST TO NZE COMPARISON

USING DOE DEFINITION

	PASSIVE	INSOFAST	CODE-BUILT
Net Zero Construction Cost	\$624,200.00	\$608,768.00	\$659,482.00

6.05kW array,
18 panels

6.30kW array,
18 panels

25.5kW array,
74 panels

Using:

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

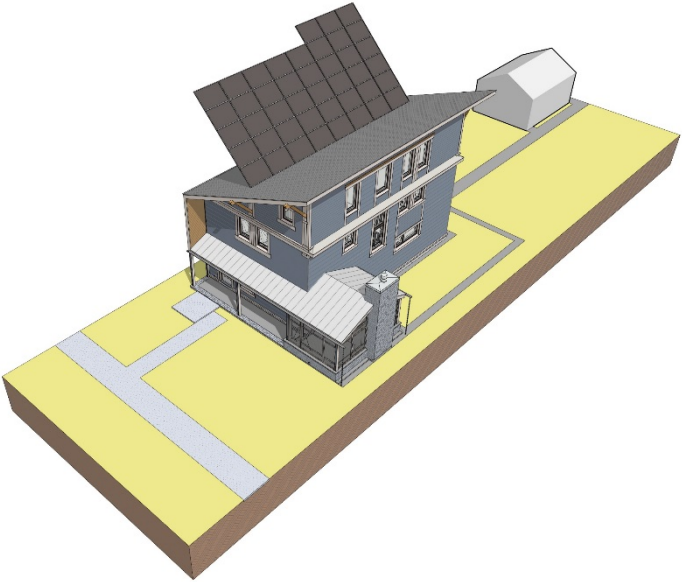
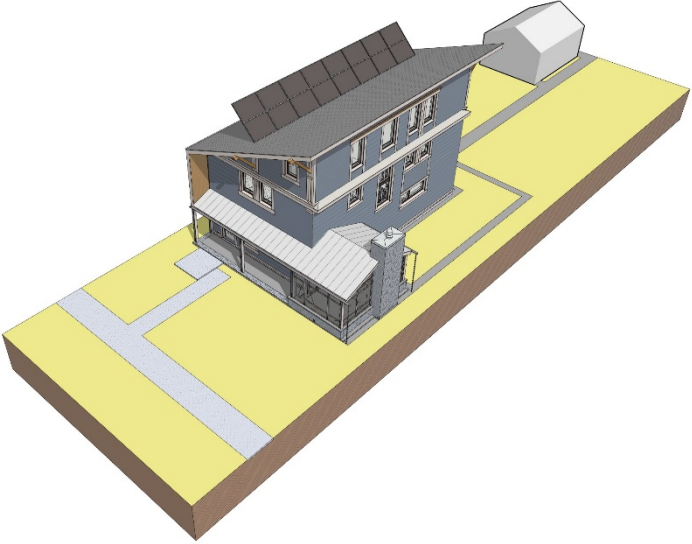
	PASSIVE	INSOFAST	CODE-BUILT
Net Zero Construction Cost	\$783,000.00	\$776,790.00	\$835,894.00

8.25kW array,
24 panels

8.5 kW array,
25 panels

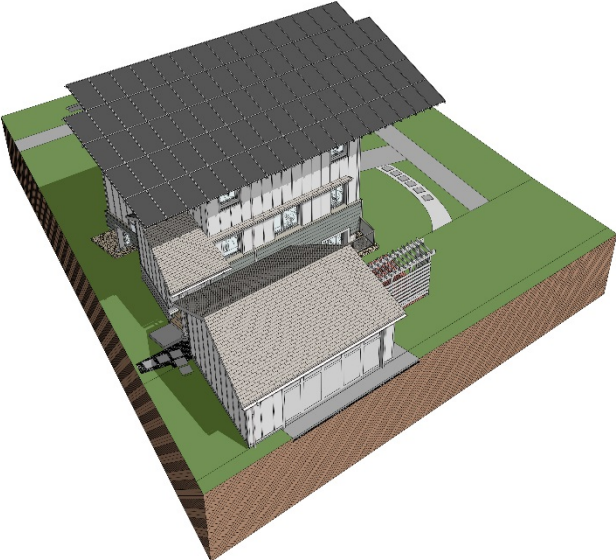
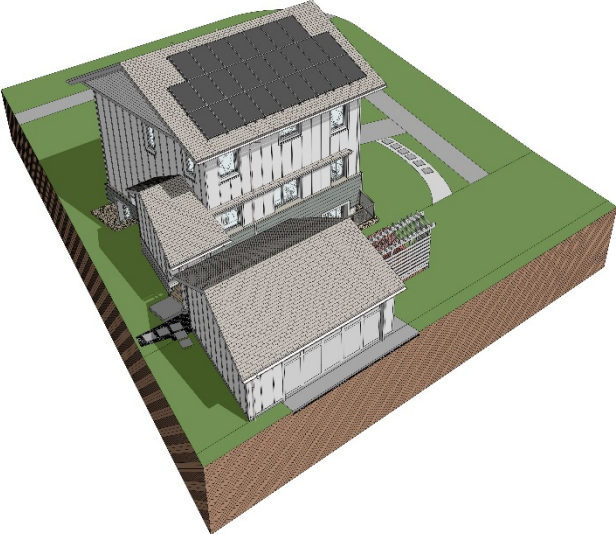
83 kW array,
83 panels

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

