Will it ever be enough

Some reasons to insulate

- Comfort
- Ecology
- Durability
- Cost

Case Study

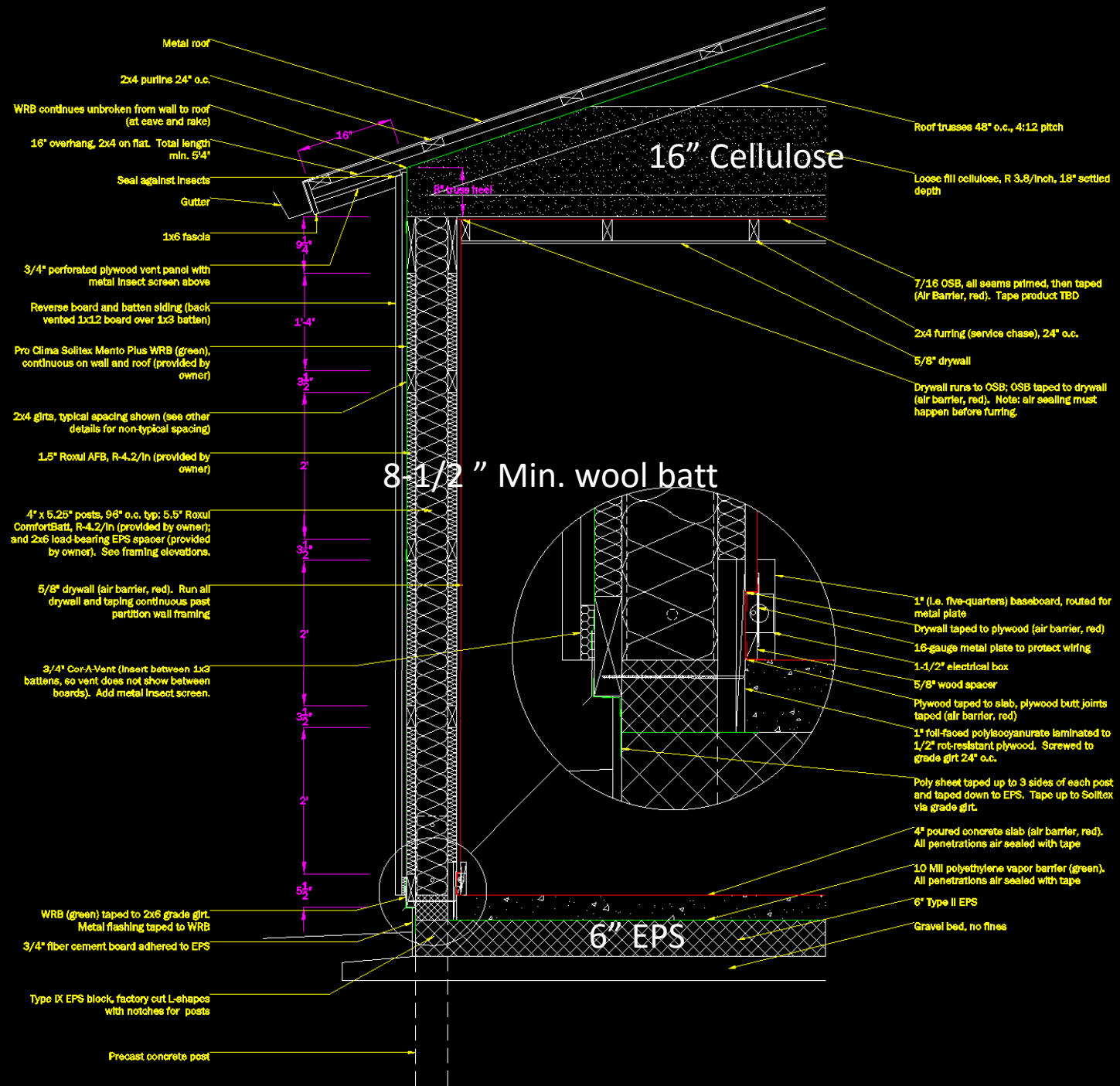
Cuddeback House, Huguenot NY

Project objectives

- Healthy comfortable house
- Net zero
- Minimum construction cost

Design Strategies:

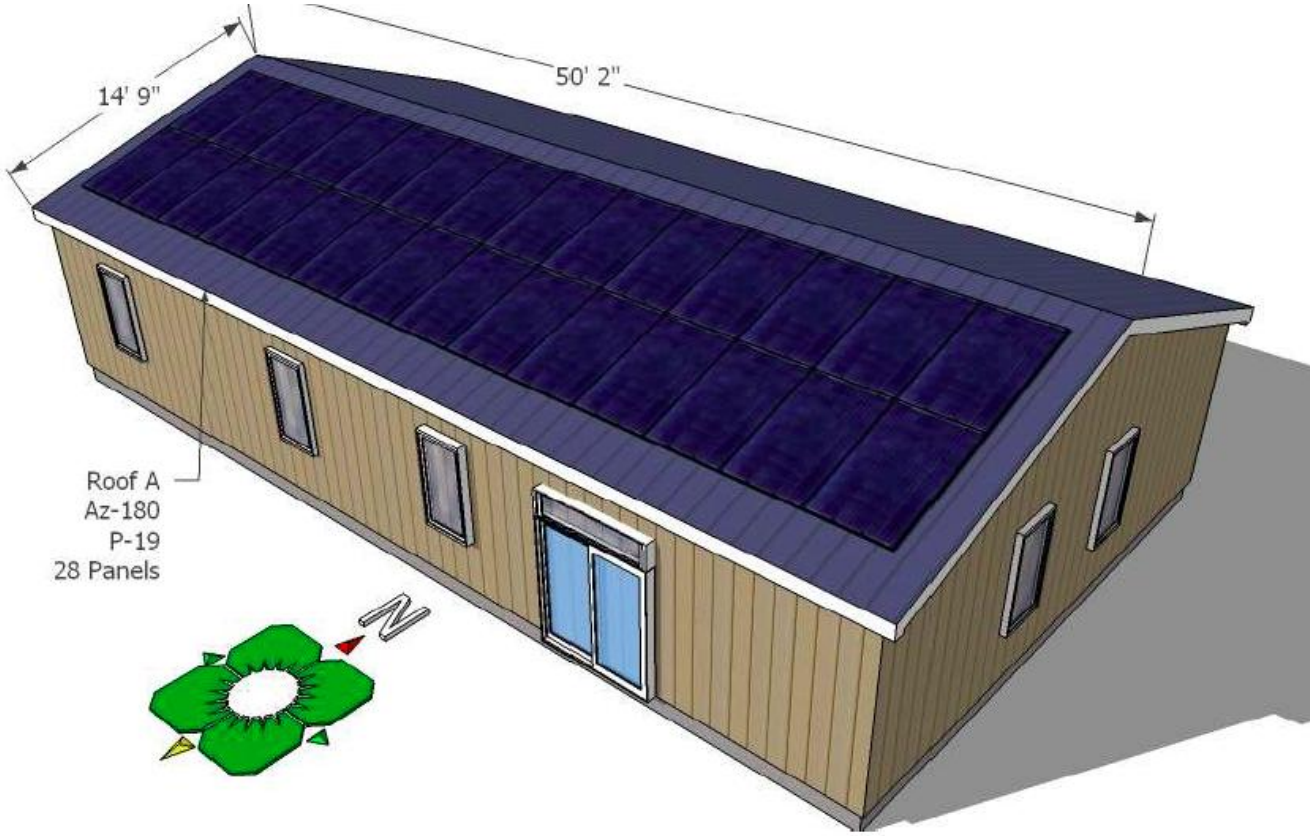
- **Adapted post-frame construction**
- Simple cost optimization model
- Cheap, efficient heating/cooling system


Metal roof
2x4 purlins 24" o.c.
WRB continues unbroken from wall to roof (at eave and rake)
16" overhang, 2x4 on flat. Total length min. 5'4"
Seal against insects
Gutter
1x6 fascia
3/4" perforated plywood vent panel with metal insect screen above
Reverse board and batten siding (back vented 1x12 board over 1x3 batten)
Pro Clima Solitex Mento Plus WRB (green), continuous on wall and roof (provided by owner)
2x4 girts, typical spacing shown (see other details for non-typical spacing)
1.5" Roxul AFB, R-4.2/in (provided by owner)
4" x 5.25" posts, 96" o.c. typ; 5.5" Roxul ComfortBatt, R-4.2/in (provided by owner); and 2x6 load-bearing EPS spacer (provided by owner). See framing elevations.
5/8" drywall (air barrier, red). Run all drywall and taping continuous past partition wall framing
3/4" Cor-A-Vent (insert between 1x3 battens, so vent does not show between boards). Add metal insect screen.
WRB (green) taped to 2x6 grade girt. Metal flashing taped to WRB
3/4" fiber cement board adhered to EPS
Type IX EPS block, factory cut L-shapes with notches for posts
Precast concrete post
16"
8" truss heel
16" Cellulose
8-1/2 " Min. wool batt
6" EPS
Roof trusses 48" o.c., 4:12 pitch
Loose fill cellulose, R 3.8/inch, 18" settled depth
7/16 OSB, all seams primed, then taped (Air Barrier, red). Tape product TBD
2x4 furring (service chase), 24" o.c.
5/8" drywall
Drywall runs to OSB; OSB taped to drywall (air barrier, red). Note: air sealing must happen before furring.
1" (i.e. five-quarters) baseboard, routed for metal plate
Drywall taped to plywood (air barrier, red)
16-gauge metal plate to protect wiring
1-1/2" electrical box
5/8" wood spacer
Plywood taped to slab, plywood butt joints taped (air barrier, red)
1" foil-faced polyisocyanurate laminated to 1/2" rot-resistant plywood. Screwed to grade girt 24" o.c.
Poly sheet taped up to 3 sides of each post and taped down to EPS. Tape up to Solitex via grade girt.
4" poured concrete slab (air barrier, red). All penetrations air sealed with tape
10 Mil polyethylene vapor barrier (green). All penetrations air sealed with tape
6" Type II EPS
Gravel bed, no fines

Design Strategies:

- Adapted post frame construction
- **Simple cost optimization model**
- Cheap, efficient heating/cooling system

1) Compare cost of measure to save energy against PV to generate the same amount (but don't exceed available roof area)
2) Aim for ~25 year marginal payback



Parametric studies	Before (kWhth/a)	After (kWhth/a)	Savings ($/a)	Cost Add	Marginal Paybk (yrs)	PV cost subsidized	PV cost unsbsdzd	
Inner Roxul batt	4526	4300	$9	$229	25	$95	$328	no labor (owner installed)
12"-16" attic cell	4720	4406	$13	$312	25	$132	$455	contractor pricing
16-24" attic cell	4406	4087	$13	$936	73	$134	$463	contractor pricing
4"-6" subslab	4839	4300	$22	$539	25	$226	$782	labor cost excluded
6"-8" subslab	4300	3989	$12	$539	43	$131	$451	labor cost excluded

Heating COP	2.5	
Electric Price	0.10	$/kWh
PV cost, subsidized	$1,260	/kWpk
unsubsidized	$4,350	/kWpk

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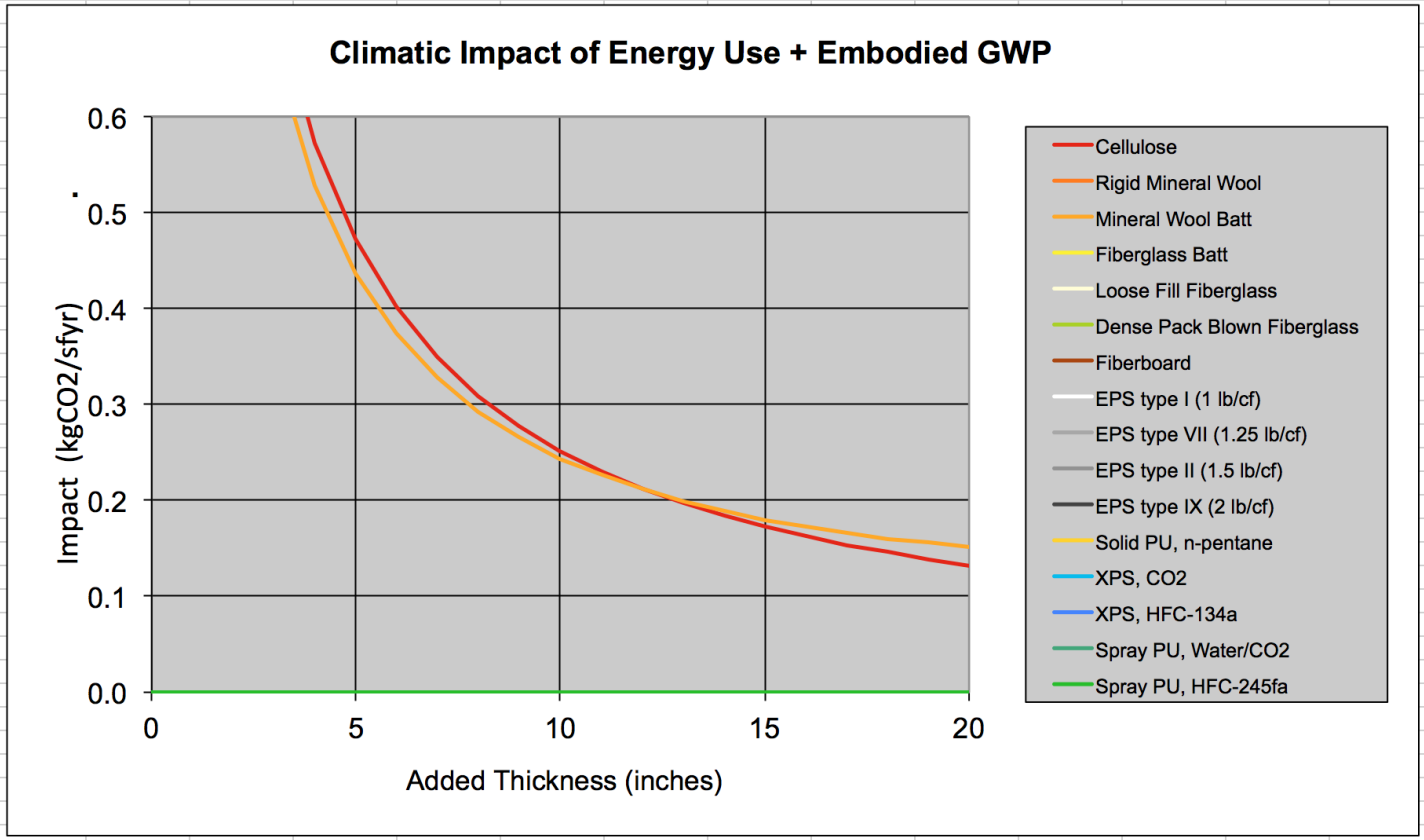
Total Climatic Impact of Insulation

Inputs	
Climate HDD (°Fd)	5,800
Reference R Value	2.5
Heating Fuel	Electricity
Heating Efficiency/COP	2.50
Life Span of Insulation (Years)	50
BA Release Rate	All
Chart Type	Thickness
R Value Chart x-axis maxiumum	60
Thickness Chart x-axis maximum	20
Chart y-axis maximum	0.6

Displayed in Graph (mark with "x")	
Cellulose	x
Rigid Mineral Wool	
Mineral Wool Batt	x
Fiberglass Batt	
Loose Fill Fiberglass	
Dense Pack Blown Fiberglass	
Fiberboard	
EPS type I (1 lb/cf)	
EPS type VII (1.25 lb/cf)	
EPS type II (1.5 lb/cf)	
EPS type IX (2 lb/cf)	
Solid PU, n-pentane	
XPS, CO2	
XPS, HFC-134a	
Spray PU, Water/CO2	
Spray PU, HFC-245fa	



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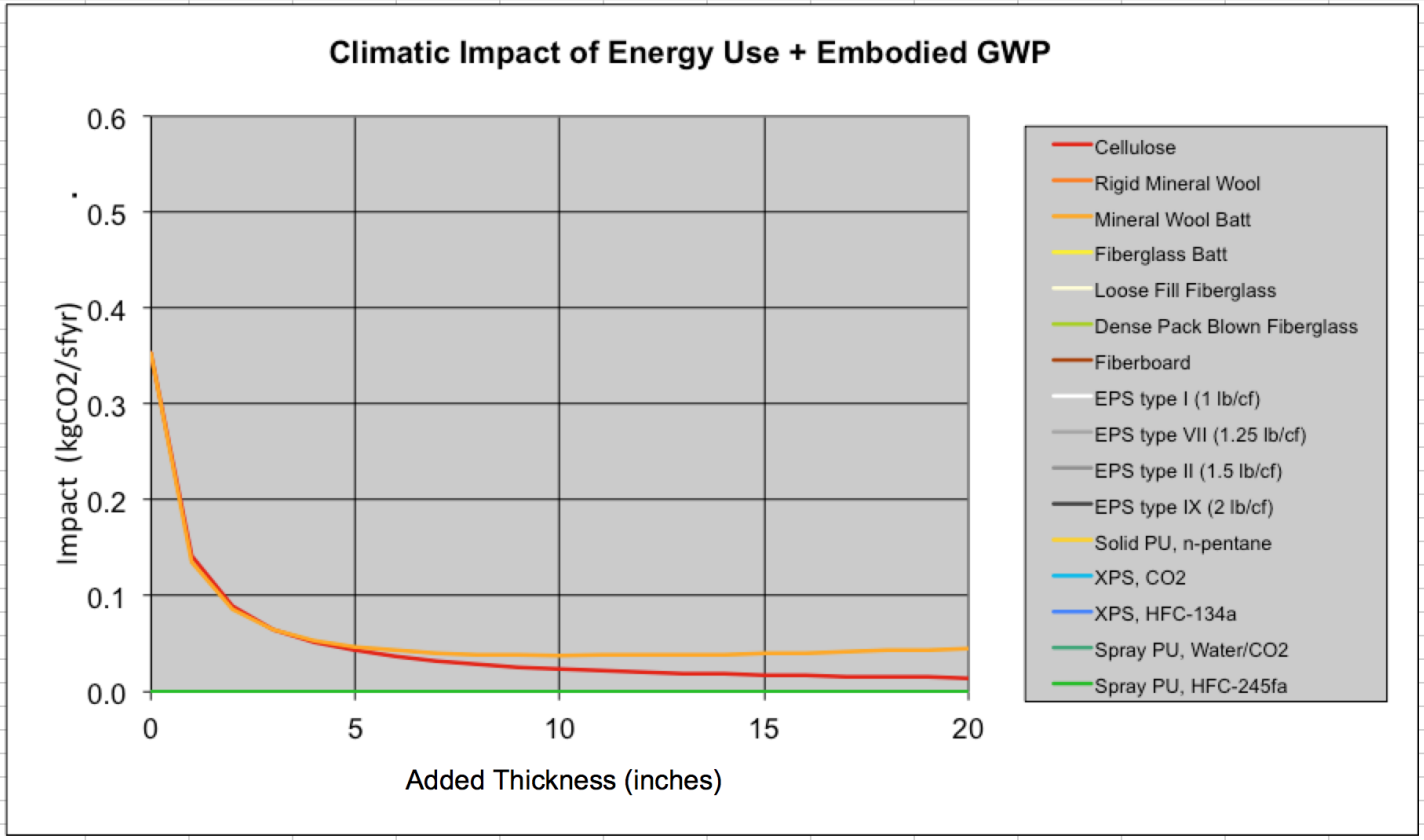

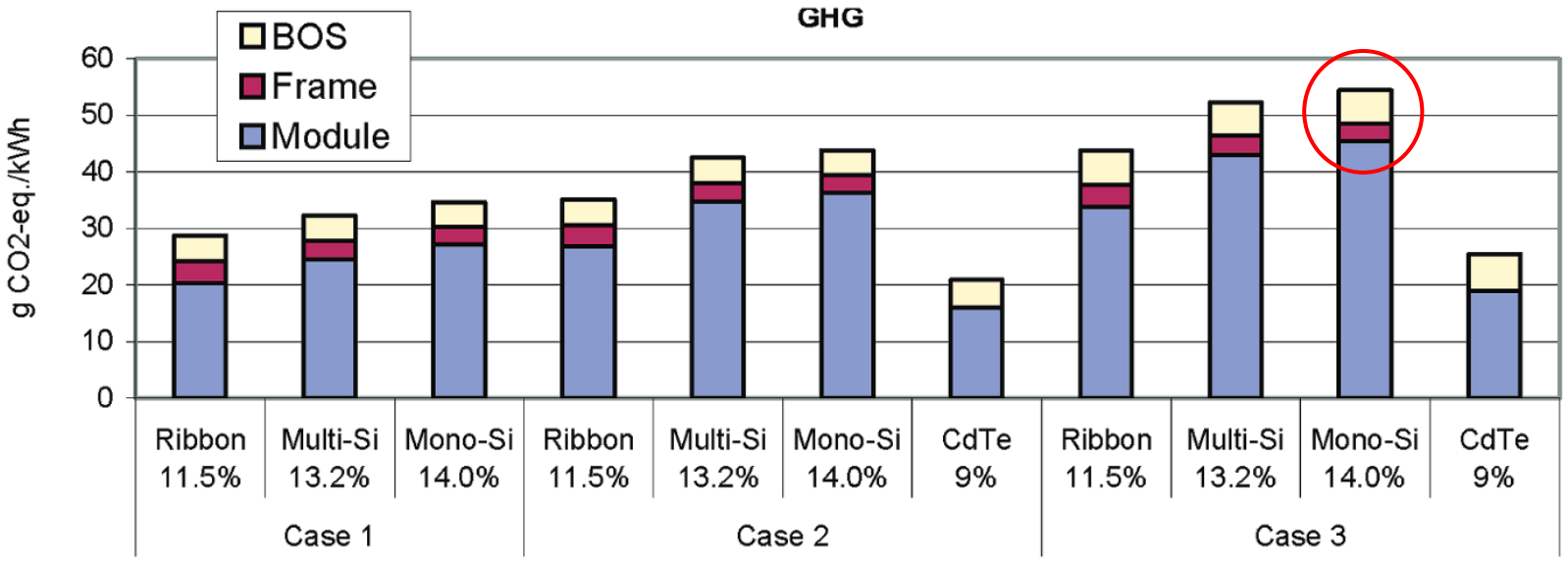

http://web.mit.edu/2.813/www/readings/esandtPV2008.pdf

Design Strategies:

- Adapted post-frame construction
- Simple cost optimization model
- **Cheap, efficient heating/cooling system**

Fujitsu AOU9-RLS2
Oversized by 110% according to PHPP

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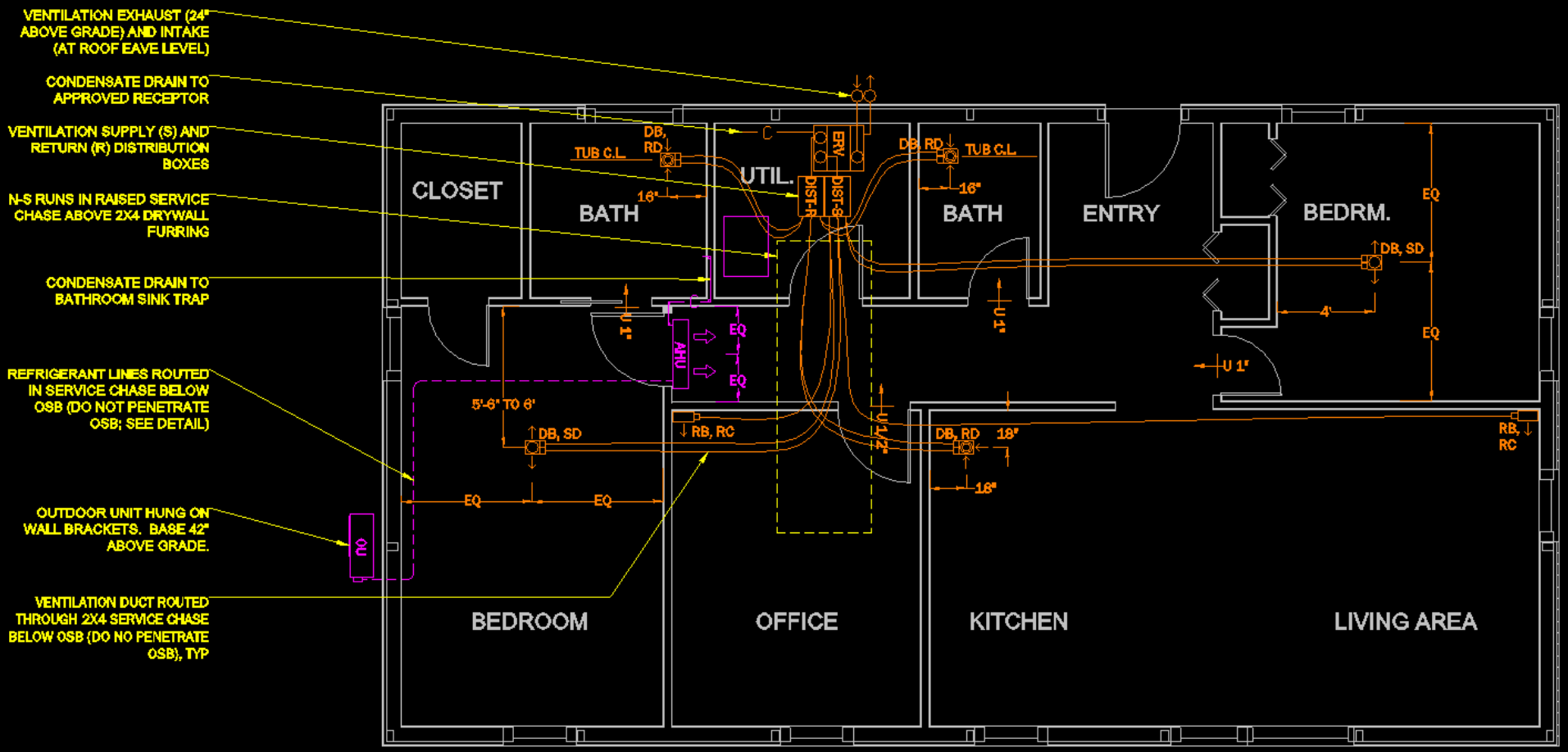
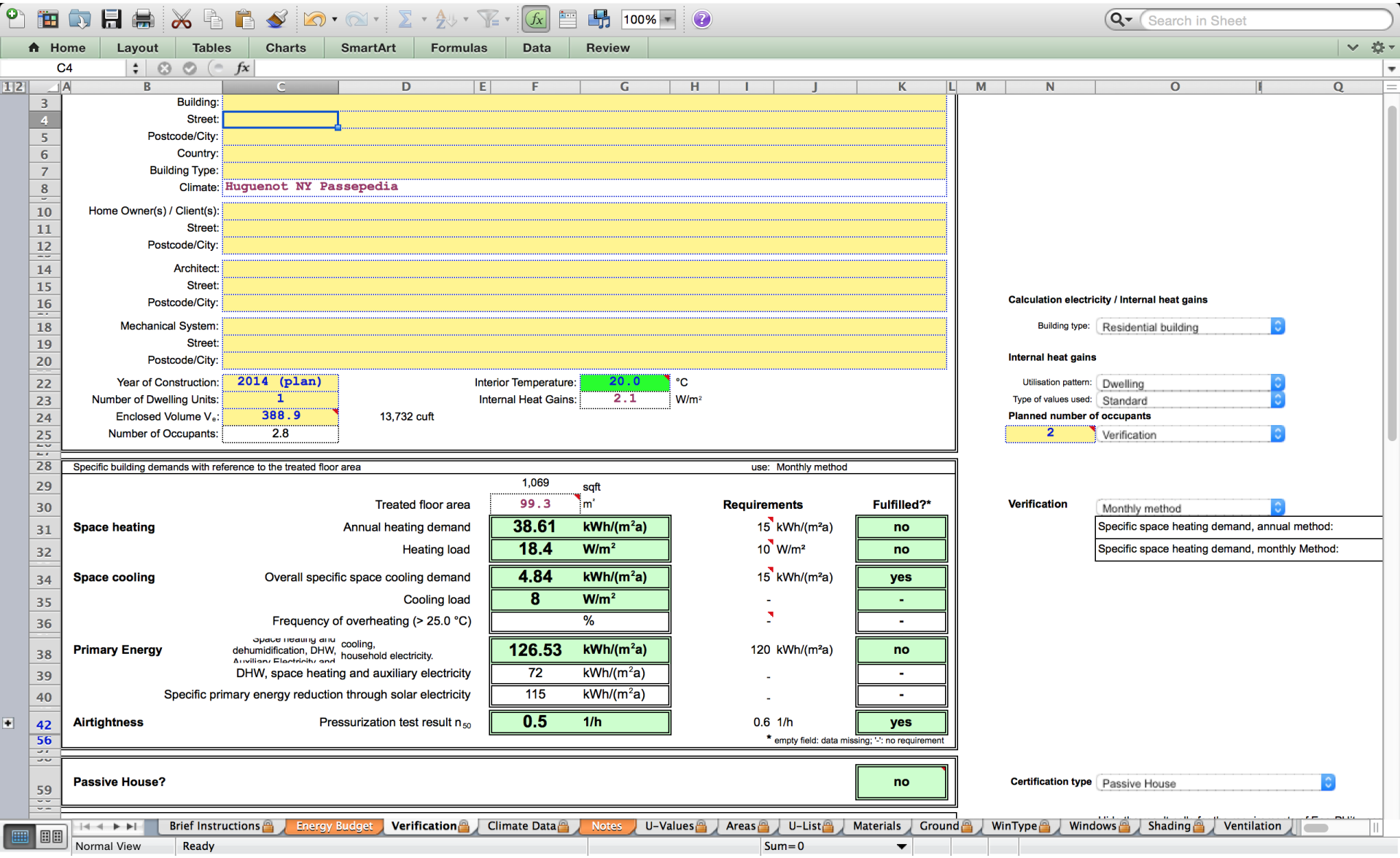
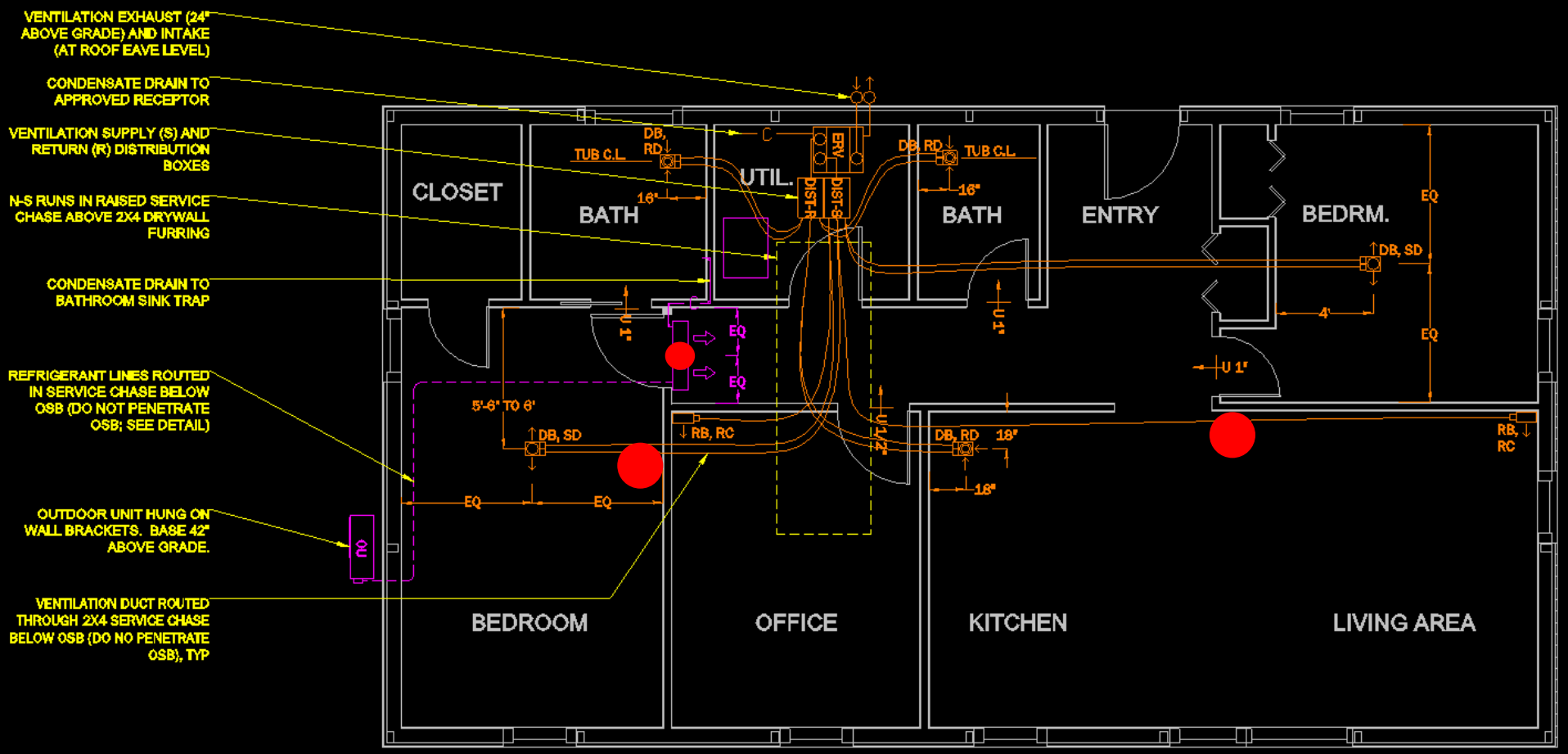




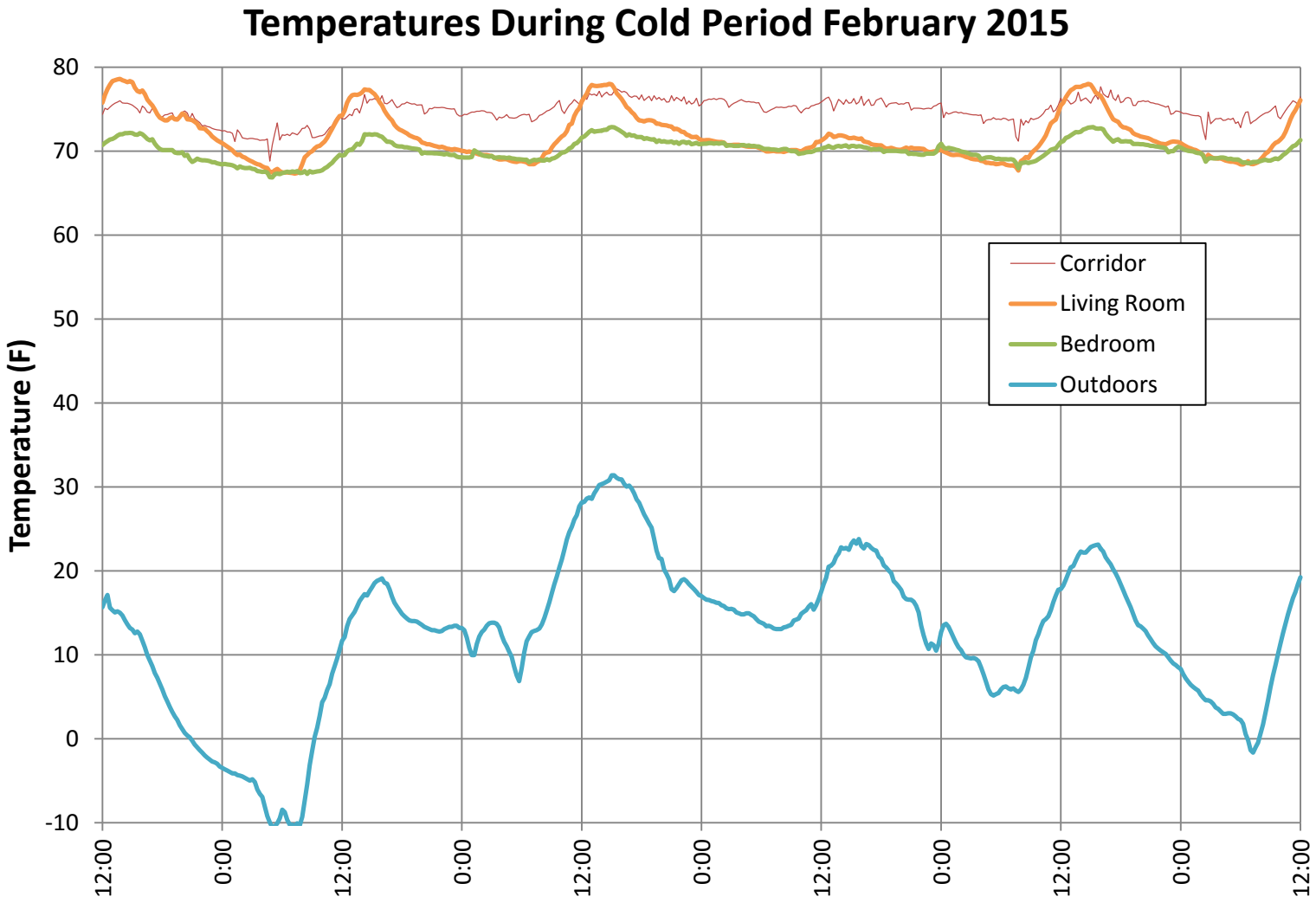
Getting this house to PH standard would require doubling R-values on all sides, highest-end Passive House windows, a Paul ERV, and tighter enclosure. The energy saved could be generated by 0.8 kW of PV ($3,400 *unsubsidized*). Which option would be cheaper? Which would have a lower carbon footprint?

Cost

So how did it go?

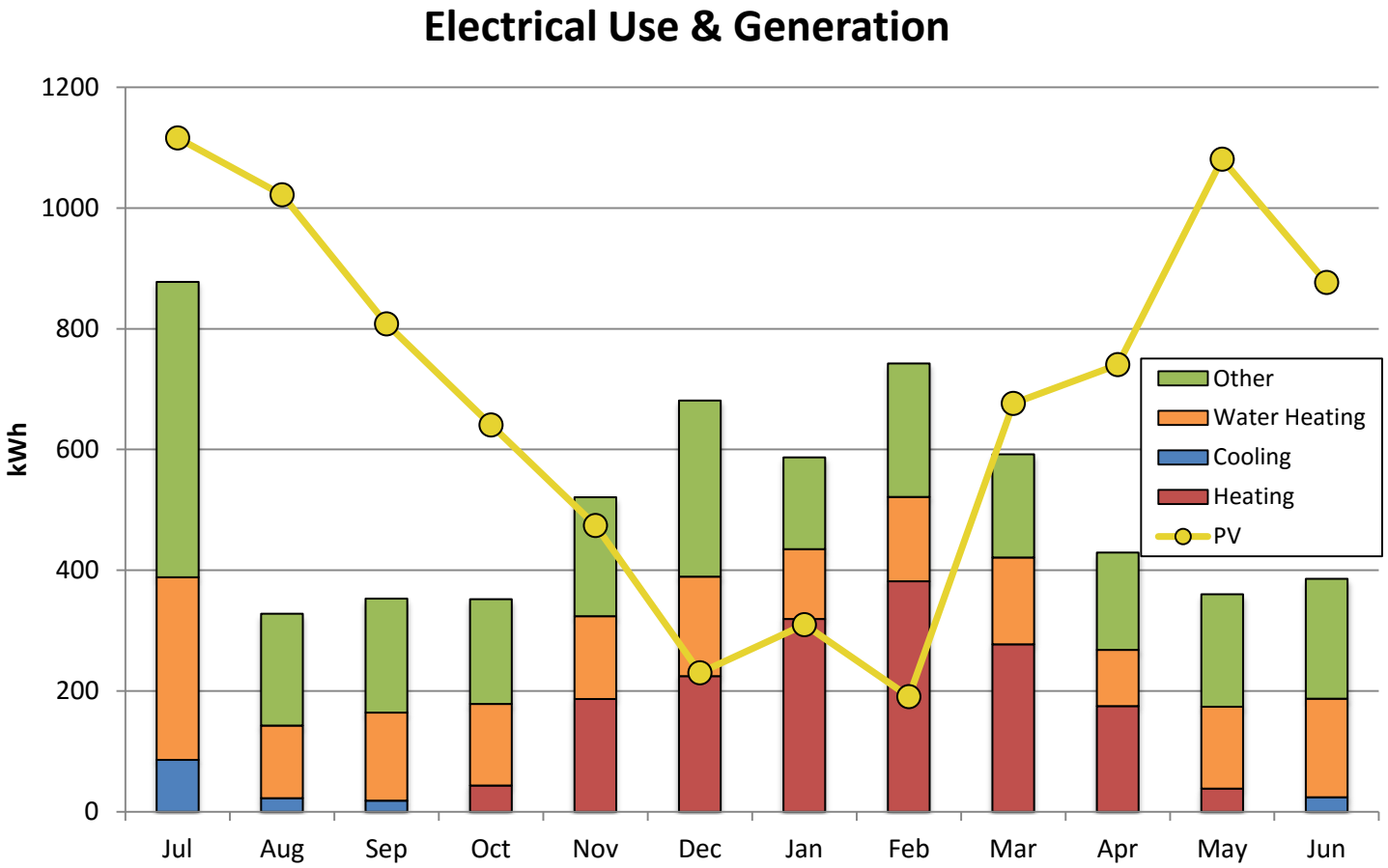

VENTILATION EXHAUST (24" ABOVE GRADE) AND INTAKE (AT ROOF EAVE LEVEL)
CONDENSATE DRAIN TO APPROVED RECEPTOR
VENTILATION SUPPLY (S) AND RETURN (R) DISTRIBUTION BOXES
N-S RUNS IN RAISED SERVICE CHASE ABOVE 2X4 DRYWALL FURRING
CONDENSATE DRAIN TO BATHROOM SINK TRAP
REFRIGERANT LINES ROUTED IN SERVICE CHASE BELOW OSB (DO NOT PENETRATE OSB; SEE DETAIL)
OUTDOOR UNIT HUNG ON WALL BRACKETS. BASE 42" ABOVE GRADE.
VENTILATION DUCT ROUTED THROUGH 2X4 SERVICE CHASE BELOW OSB (DO NO PENETRATE OSB), TYP
CLOSET
BATH
UTIL.
BATH
ENTRY
BEDRM.
BEDROOM
OFFICE
KITCHEN
LIVING AREA
ERV
DIST-S
DIST-R
TUB C.L.
DB, RD
16"
DB, SD
RB, RC
EQ
U 1"
5'-6" TO 6'
4'
18"

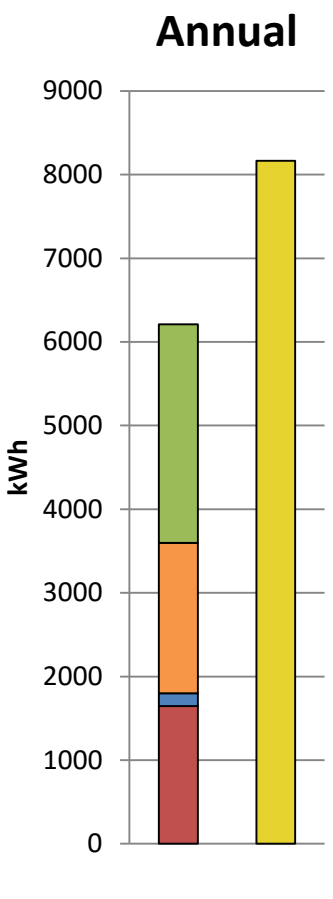
Comfort



"Comfort in winter is amazing. My wife absolutely loves 'sunbathing' in the living room. The master bath gets a little cold so we have a small heater in there for showers."

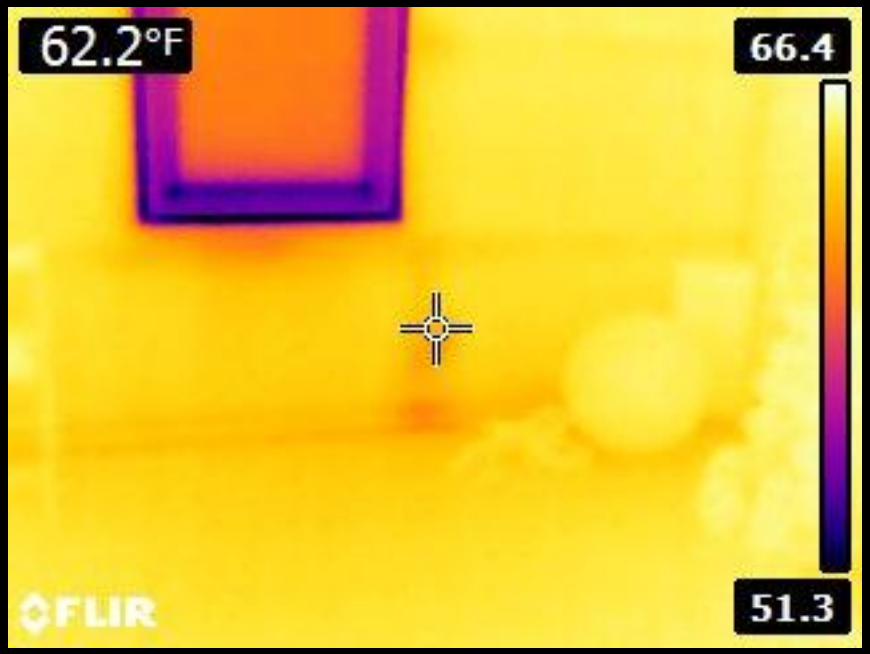
Comfort

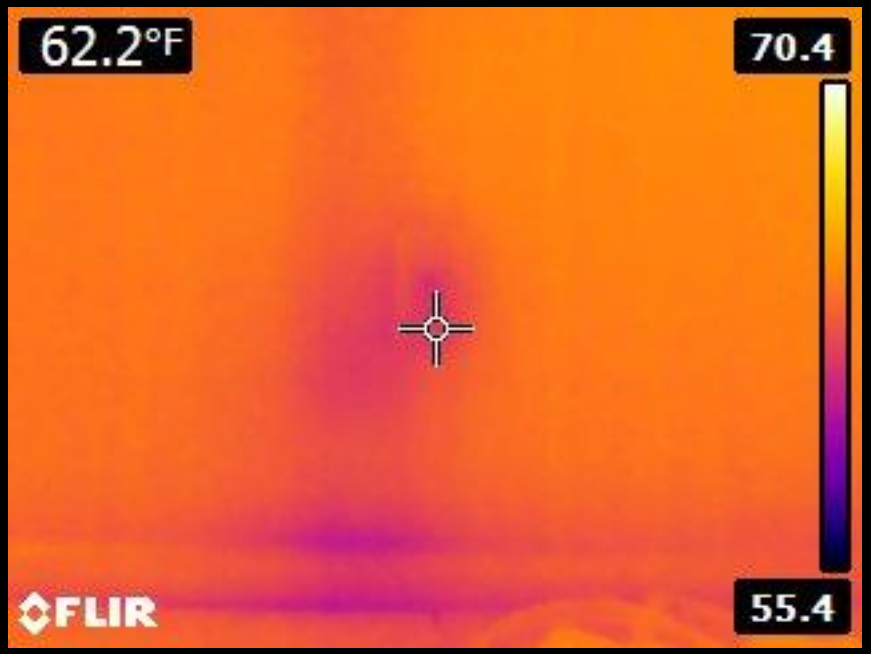

Electrical Use & Generation
kWh
1200
1000
800
600
400
200
0
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Other
Water Heating
Cooling
Heating
PV


Annual
kWh
9000
8000
7000
6000
5000
4000
3000
2000
1000
0

Ecology


Durability





Outdoor temperature -1 F

Durability

	A	B	C	D	E	F	G	H	I	J
1	**PHASES**	**DETAILS**	**Exp. 1**	**Exp. 1 Notes**	**Exp. 2**	**Exp. 2 Notes**	**Exp. 3**	**Exp. 3 Notes**	**Dispersed**	**Remaining**
2	GC Fee	John Fuller	$5,000.00	Fee					$2,000.00	$3,000.00
3	DW Fee	Energy/Performance Design and Verify	$4,000.00	Fee					$3,000.00	$1,000.00
4	Septic Design	Testing/Septic-well design	$3,000.00	Fee					$3,000.00	$0.00
5	Tam Lapp	Engineering/Consulting	$4,000.00						$4,000.00	$0.00
6	Solar	Net Cost	$8,032.50						$1,785.00	$6,247.50
7	Well	Drill, pipe, pump	$5,065.00						$5,065.00	$0.00
8	Excavation	Building pad, Tree clearing, Driveway, Trench for Electric, Septic	$18,000.00	Mat/Lab	$1,700.00	sand/gravel from dick's			$17,200.00	$2,500.00
9	Concrete Slab		$5,200.00	Mat/Lab					$5,200.00	$0.00
10	Post Frame Shell	Posts Metal Roof	$8,748.02	Materials					$8,748.02	$0.00
11	Framing Labor	Post Setting, Ext/Int Framing, Trusses, House Wrap	$7,400.00	Labor					$7,400.00	$0.00
12	Roofing/SidingLabor		$7,388.00	Labor					$600.00	$6,788.00
13	Siding Materials		$7,000.00	New Hampton Lumber		Labor Est.			$7,000.00	$0.00
14	Windows	Yaro	$7,997.00	Materials					$7,997.00	$0.00
15	Ext. Doors	Therma-tru		Neversink Lumber						$0.00
16	Neversink Lumber	Materials	$6,265.56	Month 1	$3,643.00	Month 2	$2,518.00	Month 3	$6,265.56	$6,161.00
17	Plumbing	Rough and Finish	$3,224.56	Fixtures See Tab	$6,925.00	Labor/rough pipe/fittings			$5,532.56	$4,617.00
18	HVAC	Rough and Finish	$7,799.37	Materials See Tab	$300.00	Est Labor for Huang				$8,099.37
19	Electrical	Rough and Finish	$1,000.00	Fee	$2,580.00	labor	$2,623.99	Materials total, see t	$2,623.99	$3,580.00
20	Insulation	Floors, Walls, Ceiling	$5,493.87	Total See Tab			2850	cellulose joe	$8,343.87	$0.00
21	Air Sealing	WRB/Taping Materials	5002.82	Total See Tab					$5,002.82	$0.00
22	Drywall	Hang, Tape, Finish, Texture	$6,000.00						$0.00	$6,000.00
23	Paint/Stain	Interior white	$1,200.00		$200.00	Extra coat				$1,400.00
24	Kitchen Cabinets/Counters	Materials + Counter install	$4,278.79							$4,278.79
25	Trim Package	Doors, Trim, Closets			$2,000.00	Trim Est.	$238.18	Pocket Door Frames		$2,238.18
26	Appliances		$4,000.45	See Tab						$4,000.45
27	Floor Finish	Sealer	$2,500.00	Labor	$271.11	Protective Floor Cov	$271.00	Selear	$219.00	$2,823.11
28	Tile	Bath	$1,254.37	Materials See Tab	$1,300.00	Lab Estimate		Remain Mat Est	$1,254.37	$1,300.00
29	Other		$818.36	Materials See Tab	$2,830.00	Cash Help			$818.36	$2,830.00
30										
31										
32								**TOTAL**	$103,055.55	$66,863.40
33								**Reimbursed**		
34								**Grand TOTAL**	**$169,918.95**	

Construction Costs | Draws | Cash | Electrical | HVAC | Air Sealing | Insulation | Other | Plumbing | Appliance

Cost

Plus land, closing costs, a few others: ~**$195,000**

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2 Dandee Cir, Huguenot, N...

www.zillow.com/homedetails/2-Dandee-Cir-Huguenot-NY-12746/102005090_zpid/

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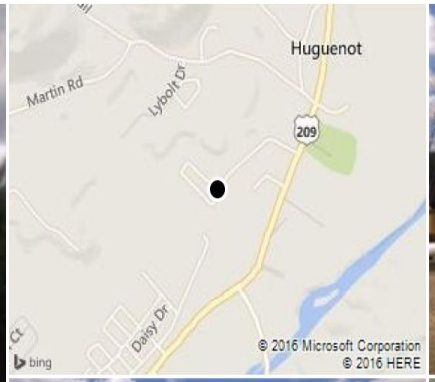

2 Dandee Cir,

Huguenot, NY 12746

3 beds · 2 baths · 1,300 sqft Edit

Edit home facts for a more accurate Zestimate.

SOLD: $204,580

Sold on 05/05/15

Zestimate®:

$181,023

Update my Zestimate

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Loretta Fay PREMIER AGENT
845-558-1637
(1)
(845) 943-4889

Lorna Sherland PREMIER AGENT
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6 Recent sales
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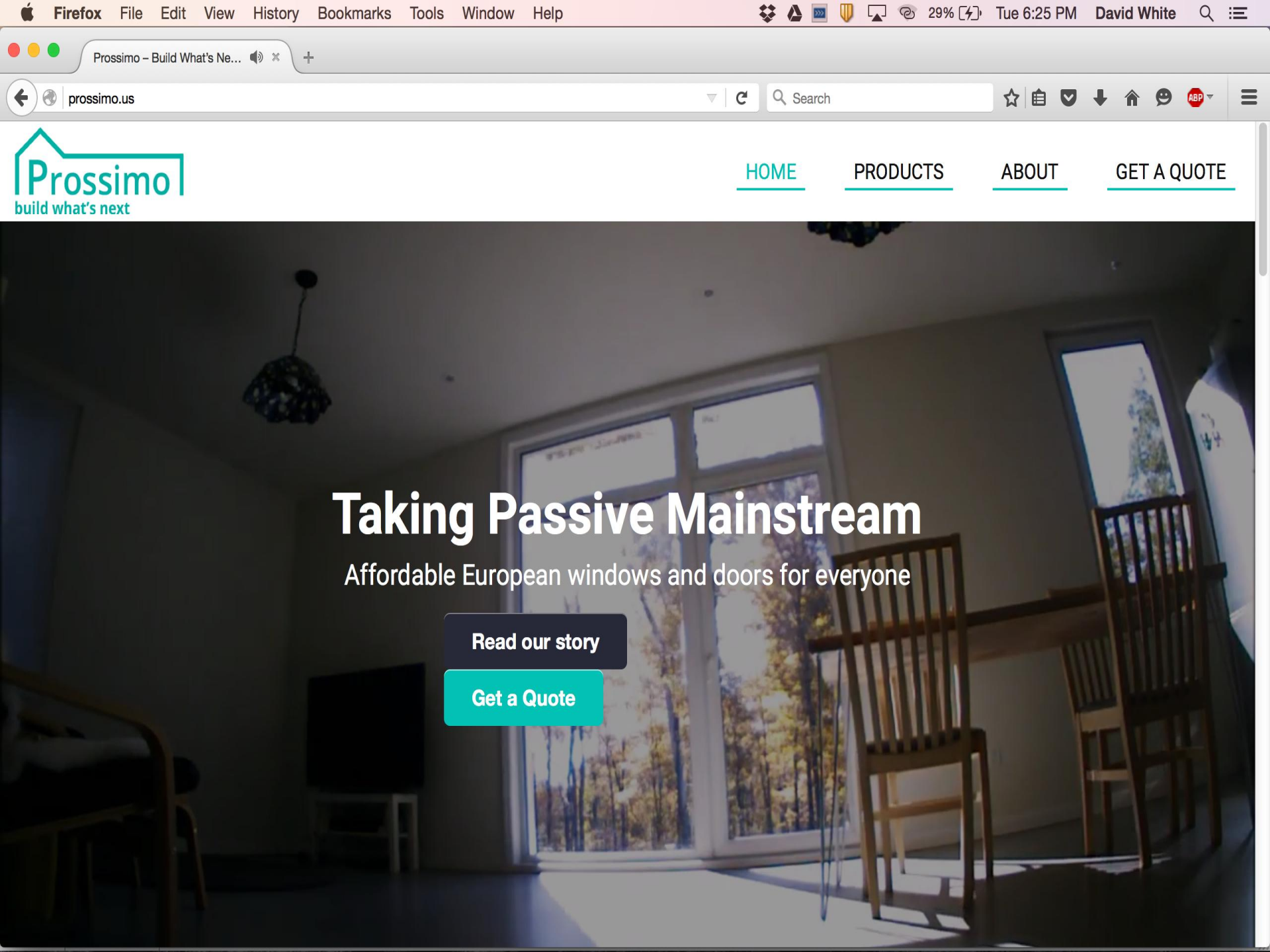
Maxine Schulte PREMIER AGENT
(11)

Cost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