

# Architecture for the Future of California



## North American Passive House Conference #14

Washington, DC, December 6, 2019

### Graham Irwin, AIA

Principal, Essential Habitat Architecture

[www.essentialhabitat.com](http://www.essentialhabitat.com)

ESSENTIAL  
HABITAT  
ARCHITECTURE



# 2008

## 1<sup>st</sup> Passive House Consultants' Training, Urbana, IL



# EH Arch Passive House Projects



# Messaging



**What's best for professionals**

# Messaging



**...is worst for clients!**

# Messaging



**Clients' #1 Question**



**What will my building look like?**

# Messaging

Audi e-tron 50 quattro

Elektrisches Antriebssystem



## Don't sell the drivetrain

Wassergekühltes Hochvolt-Ladegerät  
Water cooled HV-charger

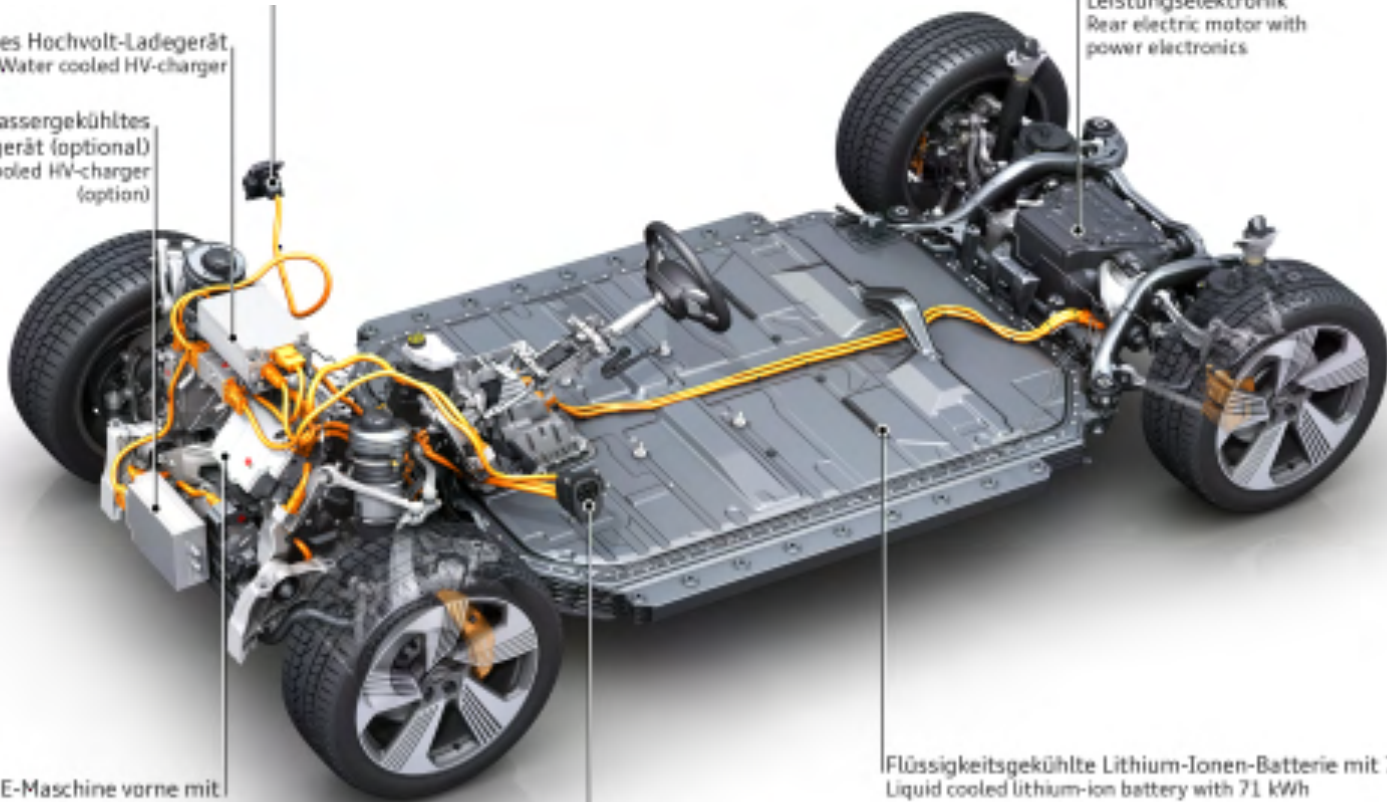
Wassergekühltes  
Hochvolt-Ladegerät (optional)  
Water cooled HV-charger  
(option)

E-Maschine hinten mit  
Leistungselektronik  
Rear electric motor with  
power electronics

E-Maschine vorne mit  
Leistungselektronik  
Front electric motor with  
power electronics

Flüssigkeitsgekühlte Lithium-Ionen-Batterie mit 71 kWh  
Liquid cooled lithium-ion battery with 71 kWh

Ladeanschluss für AC- und DC-Laden  
Charging point for AC and DC charging



# Messaging



**...sell the car!**



# Messaging



## WHAT WE DO

We create architecture that combines modernist precision with casual California indoor/outdoor ambience, optimized to Passive House (Passivhaus) standards for unmatched health, comfort, quiet and performance. Essential habitat for humans—homes, spaces, and places where people thrive, in balance with the environment. **Architecture for the future of California.**

ESSENTIAL  
HABITAT  
ARCHITECTURE



# Renewal (Retrofit)

Midori Haus, Santa Cruz



# Renewal (Retrofit)

Midori Haus, Santa Cruz



# Renewal (Retrofit)

Midori Haus, Santa Cruz



# Renewal (Retrofit)

Midori Haus, Santa Cruz

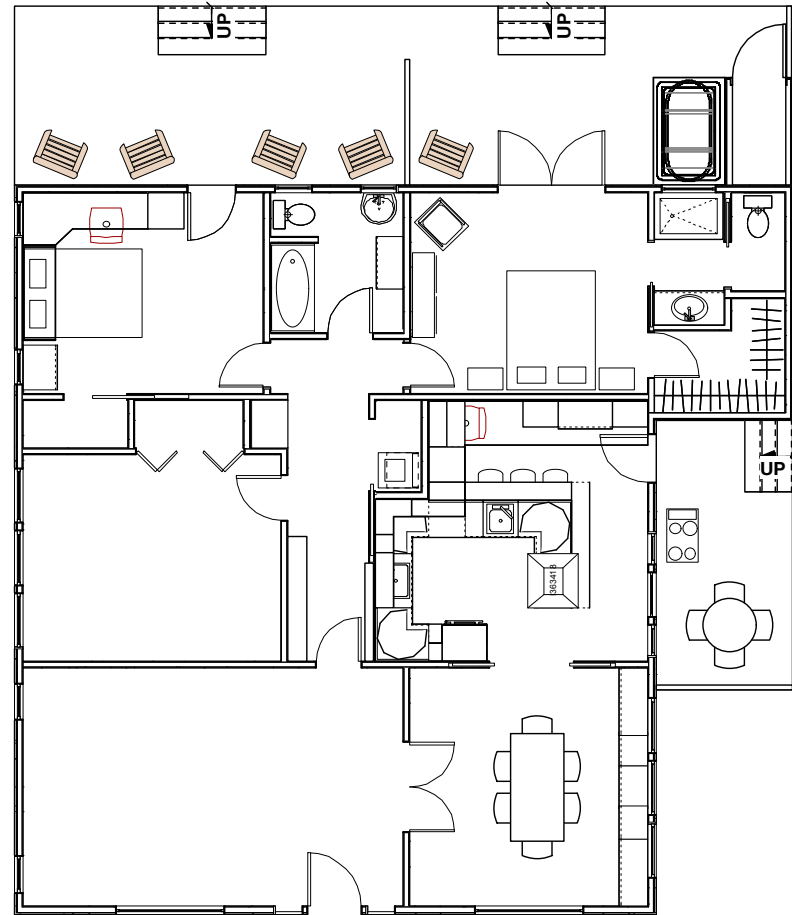
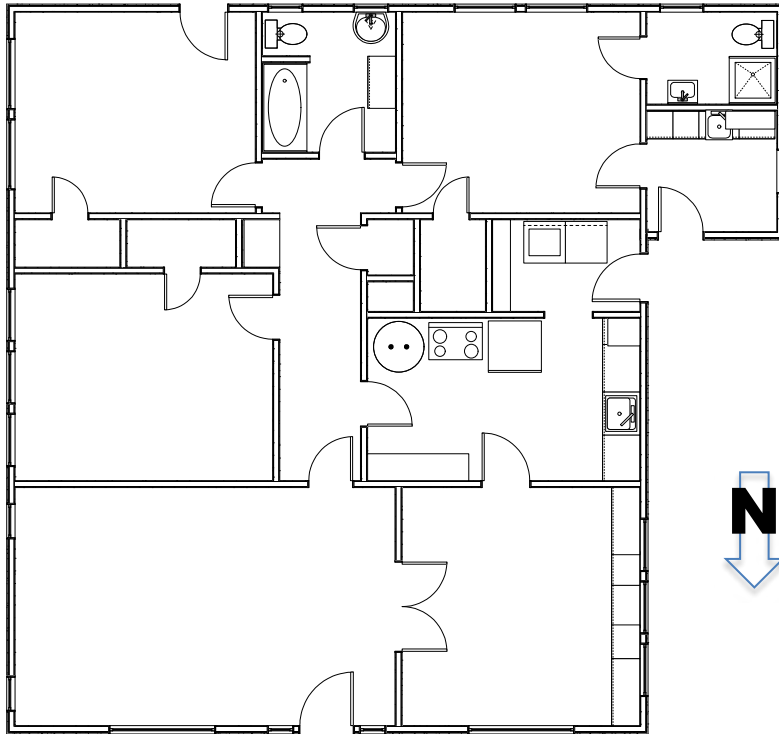


# Renewal (Retrofit)

## Midori Haus, Santa Cruz

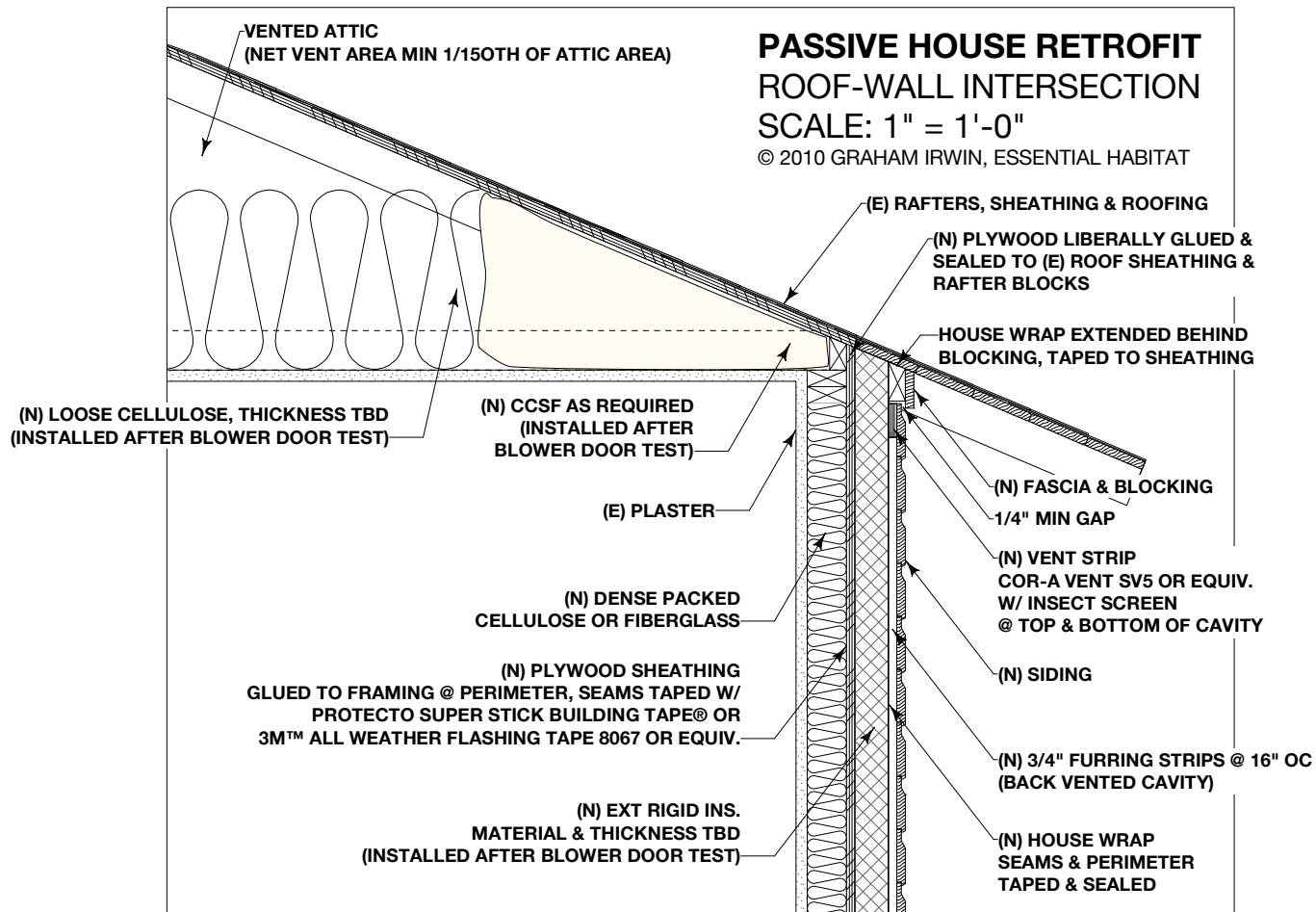
1569 ft<sup>2</sup>, 3BR/2BA

Built 1922, Remodeled 2013



# Renewal (Retrofit)

## Midori Haus, Santa Cruz



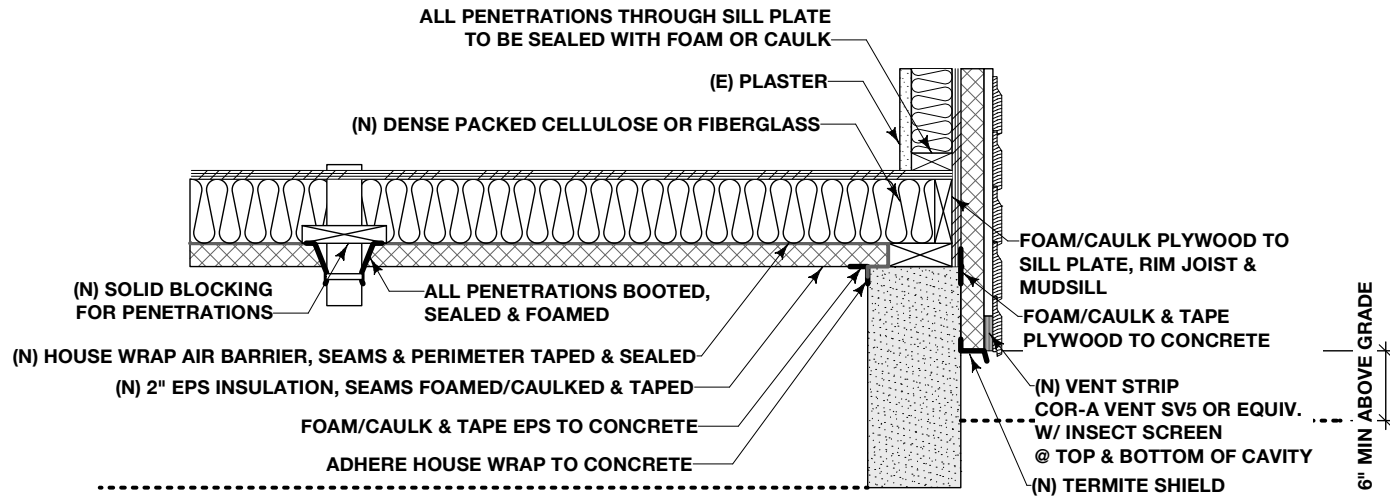
# Renewal (Retrofit)

## Midori Haus, Santa Cruz

### PASSIVE HOUSE RETROFIT FLOOR-WALL INTERSECTION

SCALE: 1" = 1'-0"

© 2011 GRAHAM IRWIN, ESSENTIAL HABITAT





# Renewal (Retrofit)

## Midori Haus, Santa Cruz

### Blower Door Testing – Before & After



Before: 22 ACH<sub>50</sub>



After: 0.6 ACH<sub>50</sub>

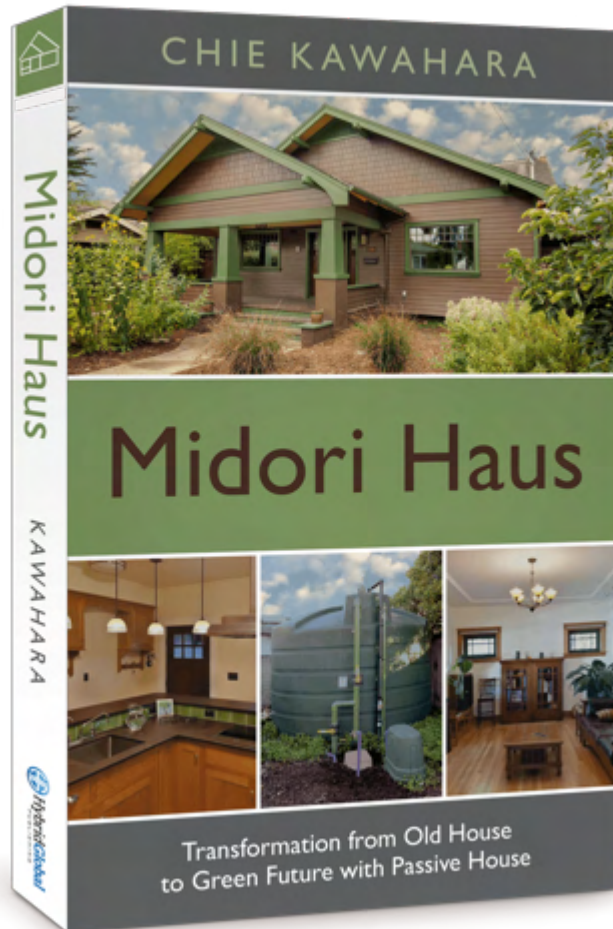


Triumphant Builders!

[www.santacruzgreenbuilders.com](http://www.santacruzgreenbuilders.com)

# Renewal (Retrofit)

## Midori Haus, Santa Cruz



[www.midorihaus.com](http://www.midorihaus.com)

# Renewal (Retrofit)

Kaplarkey Residence, San Francisco 2014



# Renewal (Retrofit)

Kaplarkey Residence, San Francisco 2014



# Renewal (Retrofit)

Kaplarkey Residence, San Francisco 2014



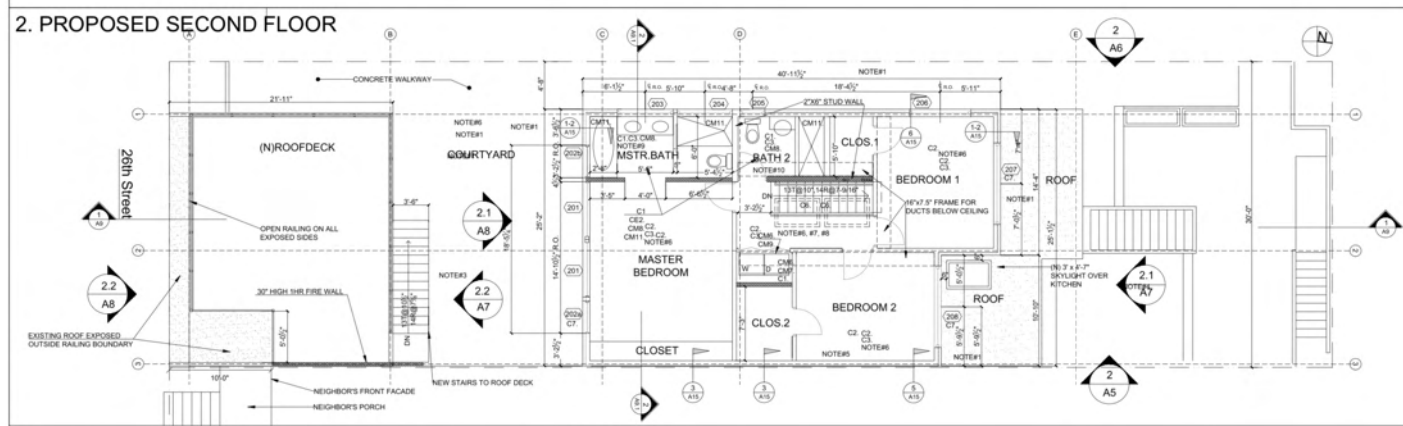
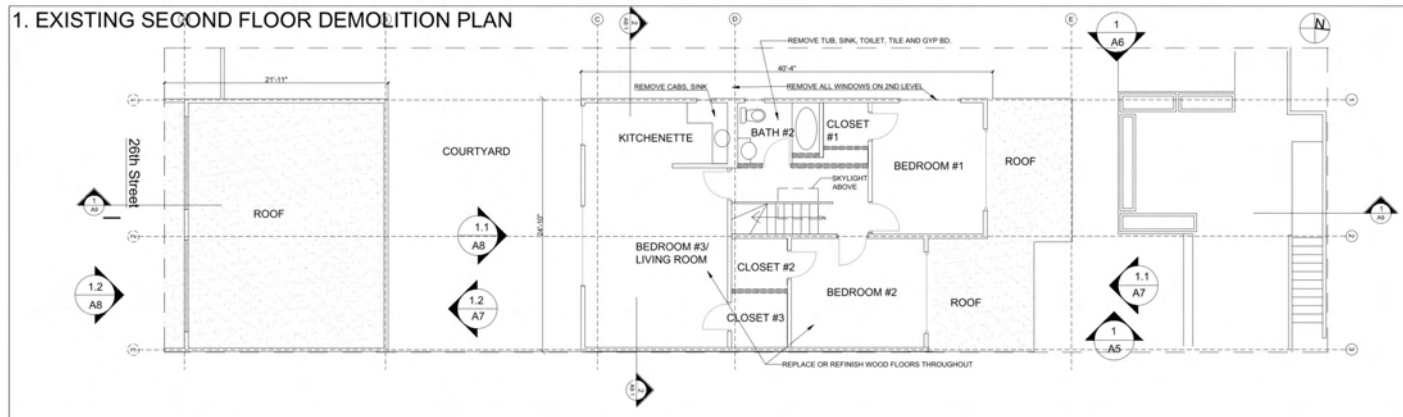
# Renewal (Retrofit)

Kaplarkey Residence, San Francisco 2014



# Renewal (Retrofit)

## Kaplarkey Residence, San Francisco 2014



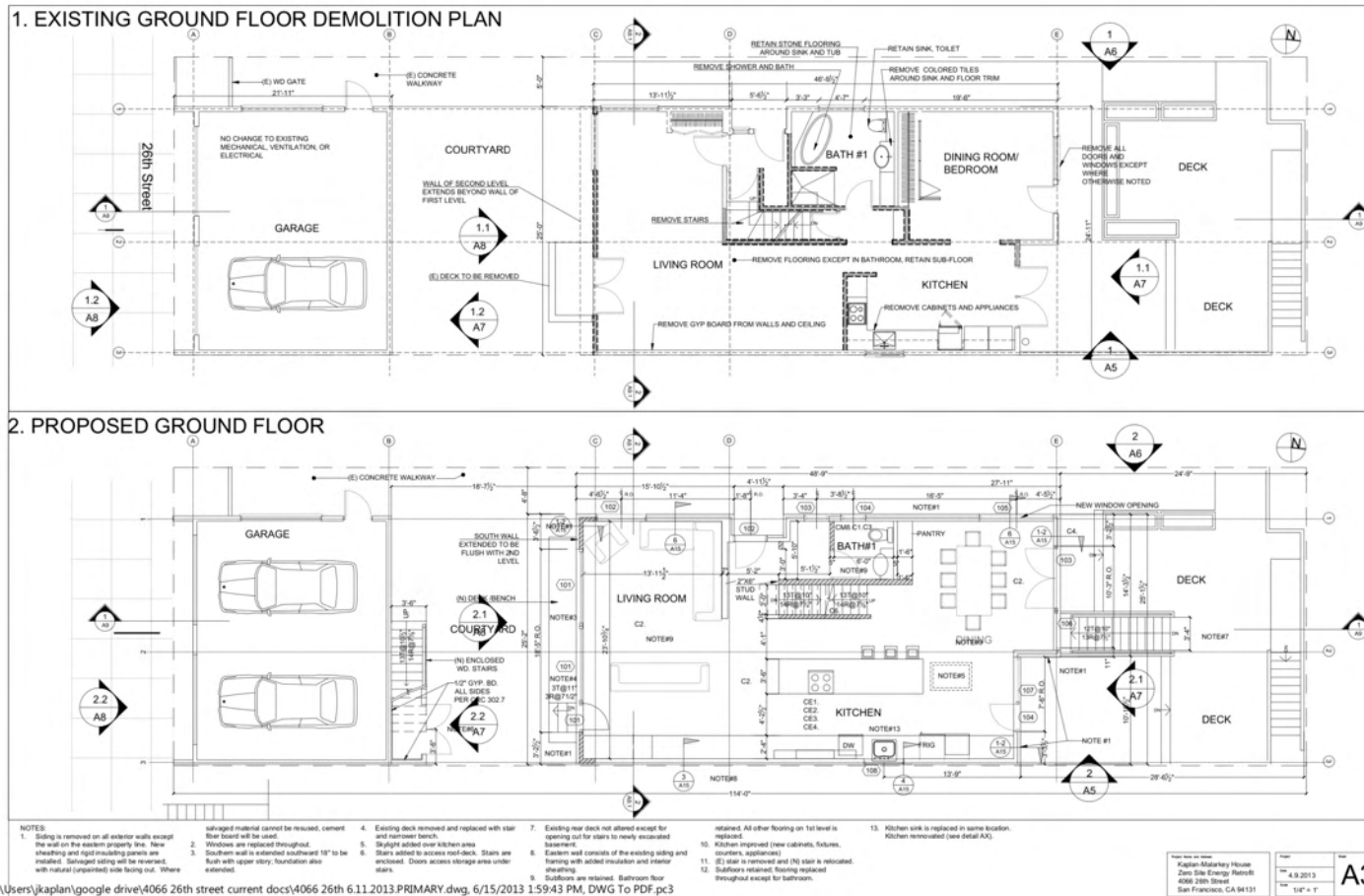
**NOTES**

- Siding is removed on all exterior walls except the wall on the eastern property line. New sheathing and rigid insulation panels are installed. Sidelap siding will be re-installed with natural unpainted side facing out. Where subsequent material cannot be re-used, remove.
- Riser board will be used for siding.
- Windows are replaced throughout.
- Stairs added to access roof deck. New deck added to roof of garage. Roof will be reinforced from inside garage.
- Sub-floors are retained. Flooring is replaced.
- Existing rear deck not altered except for opening out for stairs to level adjacent.
- Existing exterior concrete steps is re-constructed.
- Eastern wall consists of the existing siding and framing with added insulation and interior sheathing.
- Sub-floors are retained. Flooring is replaced.
- (E) stair is removed and (N) stair is relocated.
- Existing window (step) is re-constructed (replaced with two skylights), new skylight added over kitchen.
- New master bath installed with pocket door between WC and shower area. See detail.
- Bath 2 upgraded with new toilet, sink, vanity glass shower, replaced tile.

Kaplarkey House  
 436 26th Street  
 San Francisco, CA 94111  
 4.9.2013  
 A4  
 1/4" = 1'

# Renewal (Retrofit)

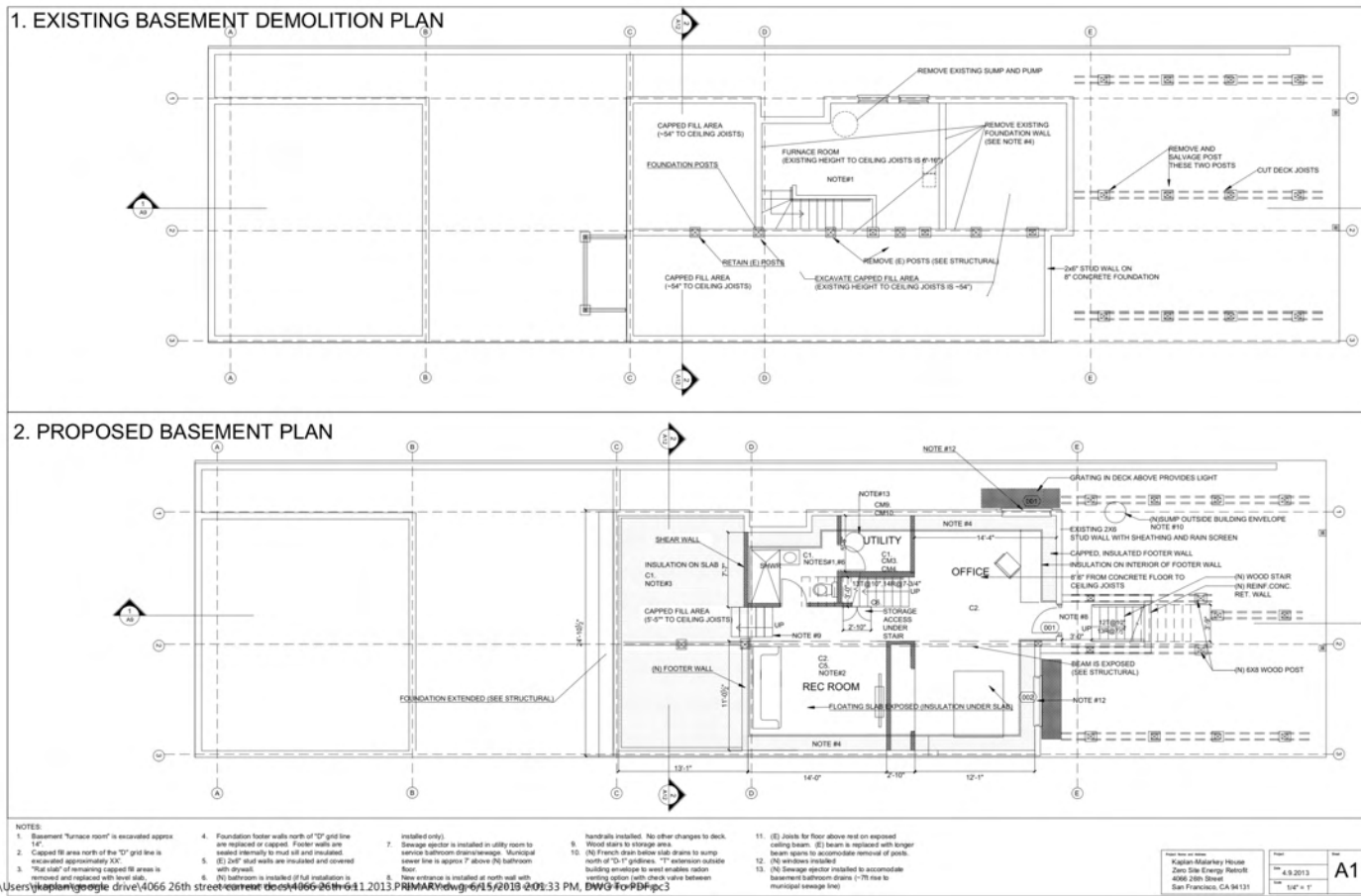
## Kaplarkey Residence, San Francisco 2014





# Renewal (Retrofit)

## Kaplarkey Residence, San Francisco 2014



# Renewal (Retrofit)

Kaplarkey Residence, San Francisco 2014



# Renewal (Retrofit)

Kaplarkey Residence, San Francisco 2014



# Renewal (Retrofit)

Kaplarkey Residence, San Francisco 2014



# Renewal (Retrofit)

Hittson Residence, San Jose



# Renewal (Retrofit)

Hittson Residence, San Jose



# Renewal (Retrofit)

Hittson Residence, San Jose



# Renewal (Retrofit)

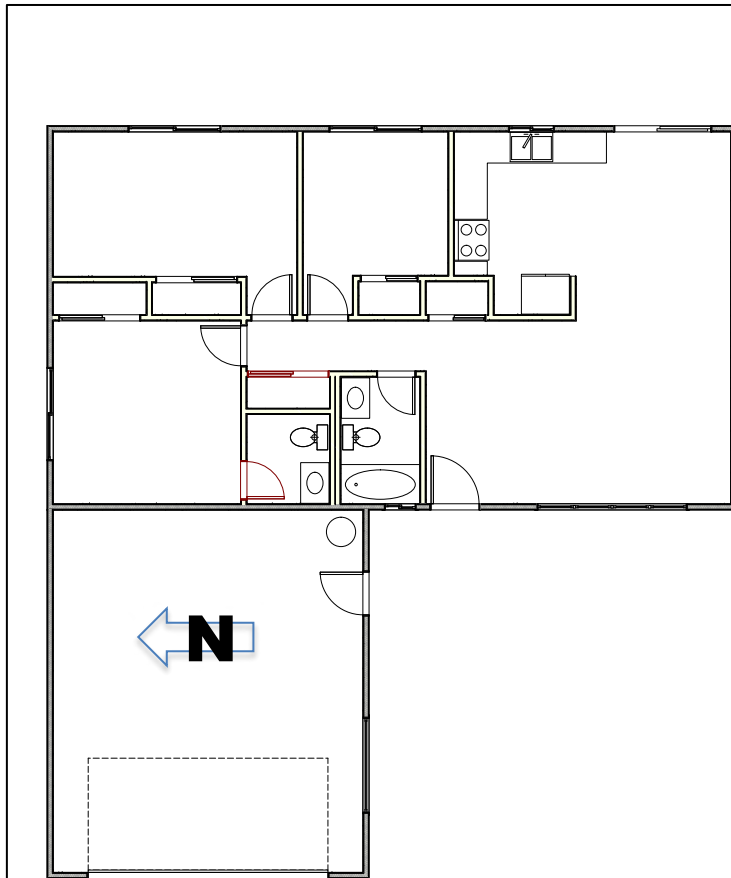
Hittson Residence, San Jose



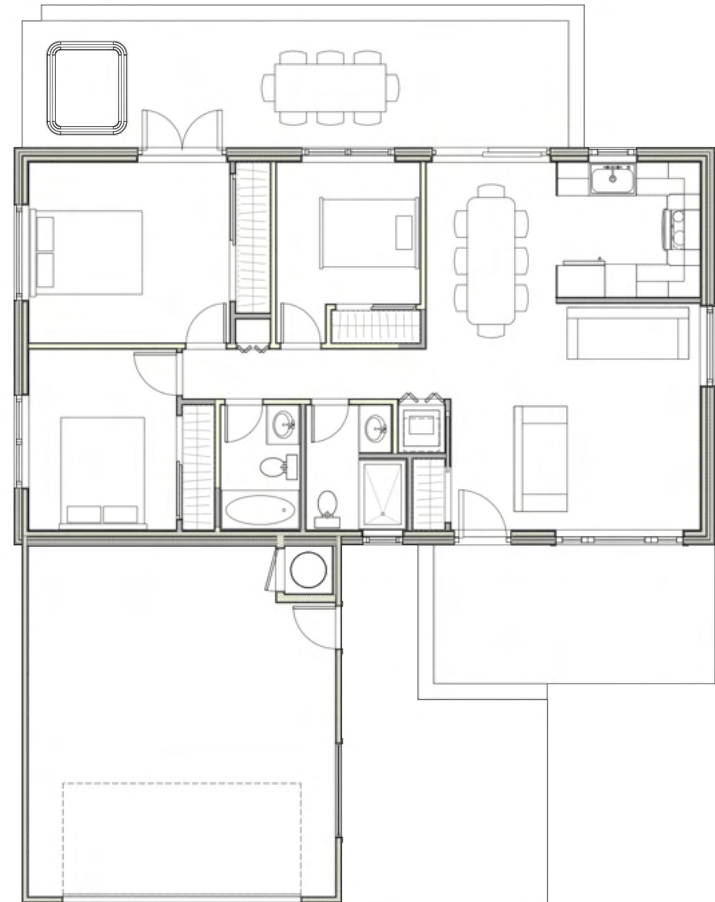


# Renewal (Retrofit)

## Hittson Residence, San Jose



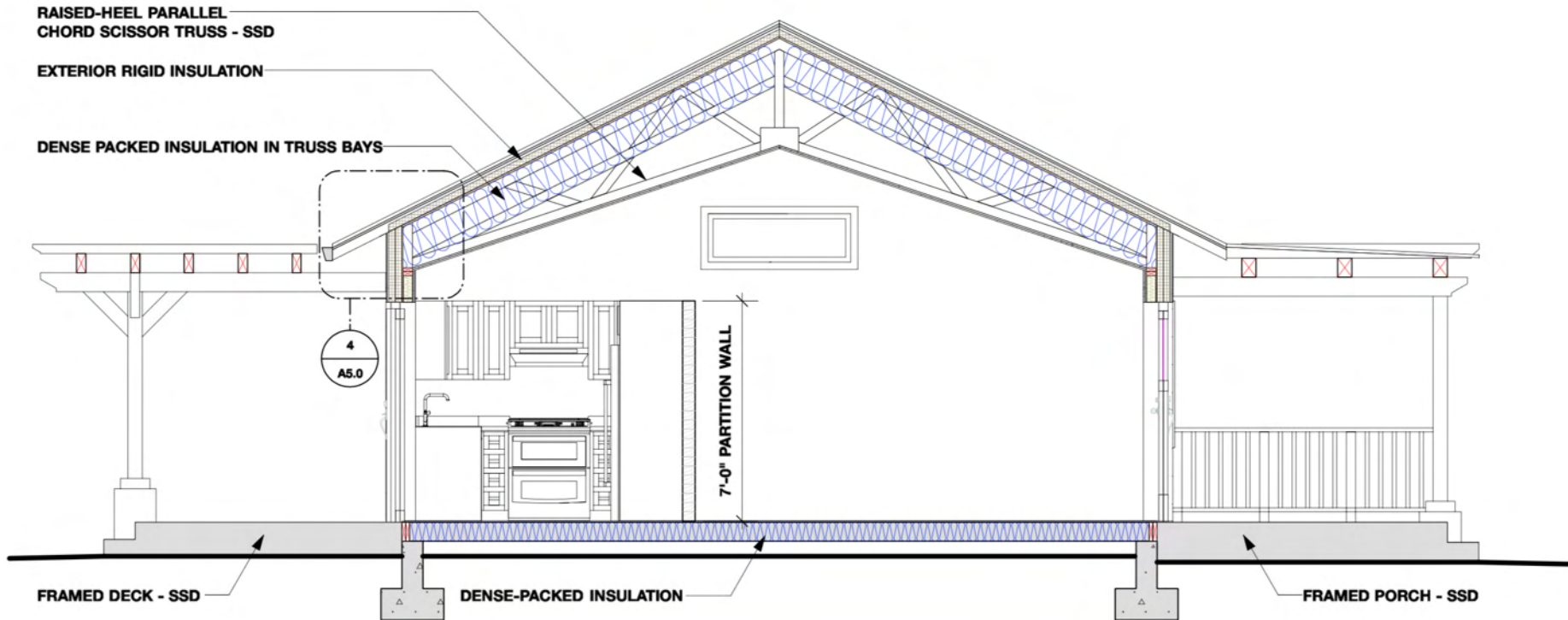
**3 BR/1½ BA, 1038 ft<sup>2</sup>**



**3 BR/2 BA, 1107 ft<sup>2</sup>**

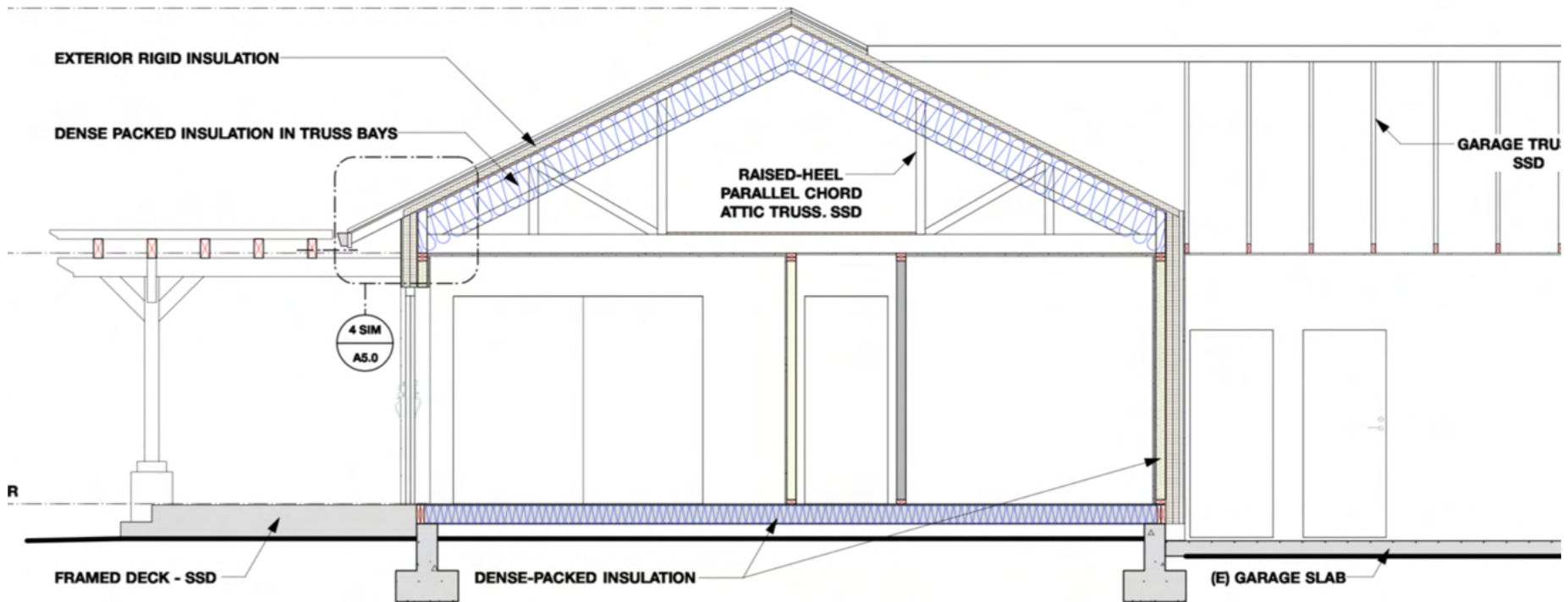
# Renewal (Retrofit)

## Hittson Residence, San Jose



# Renewal (Retrofit)

## Hittson Residence, San Jose



# Renewal (Retrofit)

Watson/Esparza Residence, Sunnyvale



# Renewal (Retrofit)

Watson/Esparza Residence, Sunnyvale



# Renewal (Retrofit)

Watson/Esparza Residence, Sunnyvale



# Renewal (Retrofit)

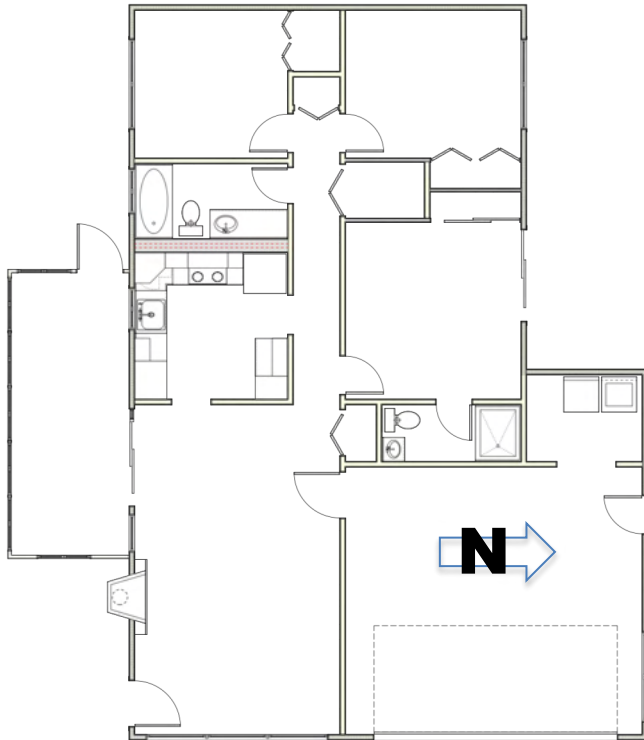
Watson/Esparza Residence, Sunnyvale



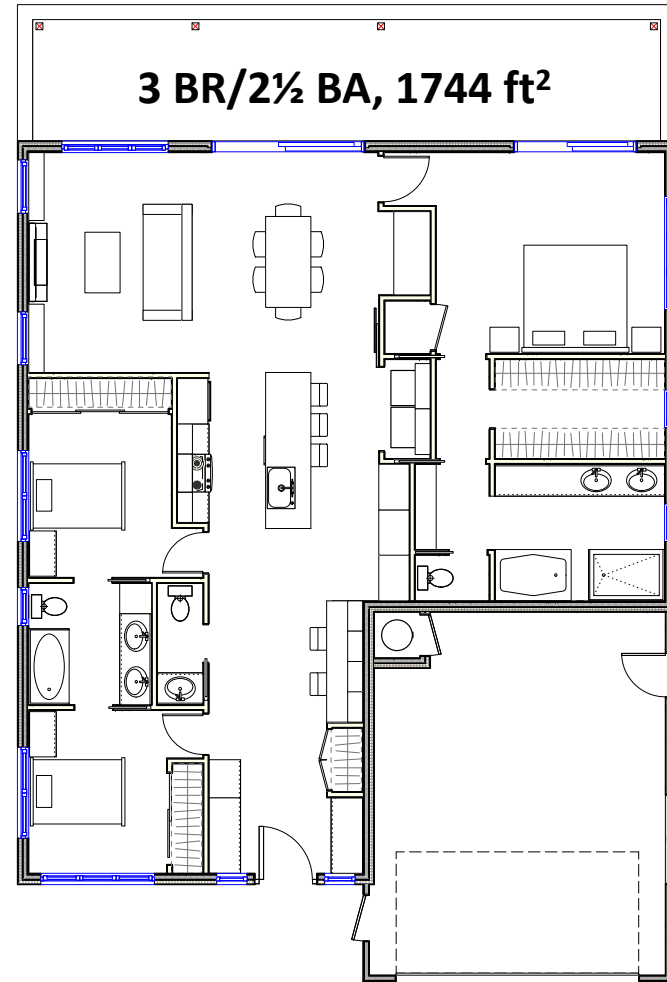
# Renewal (Retrofit)

## Watson/Esparza Residence, Sunnyvale

3 BR/2 BA, 1193 ft<sup>2</sup>



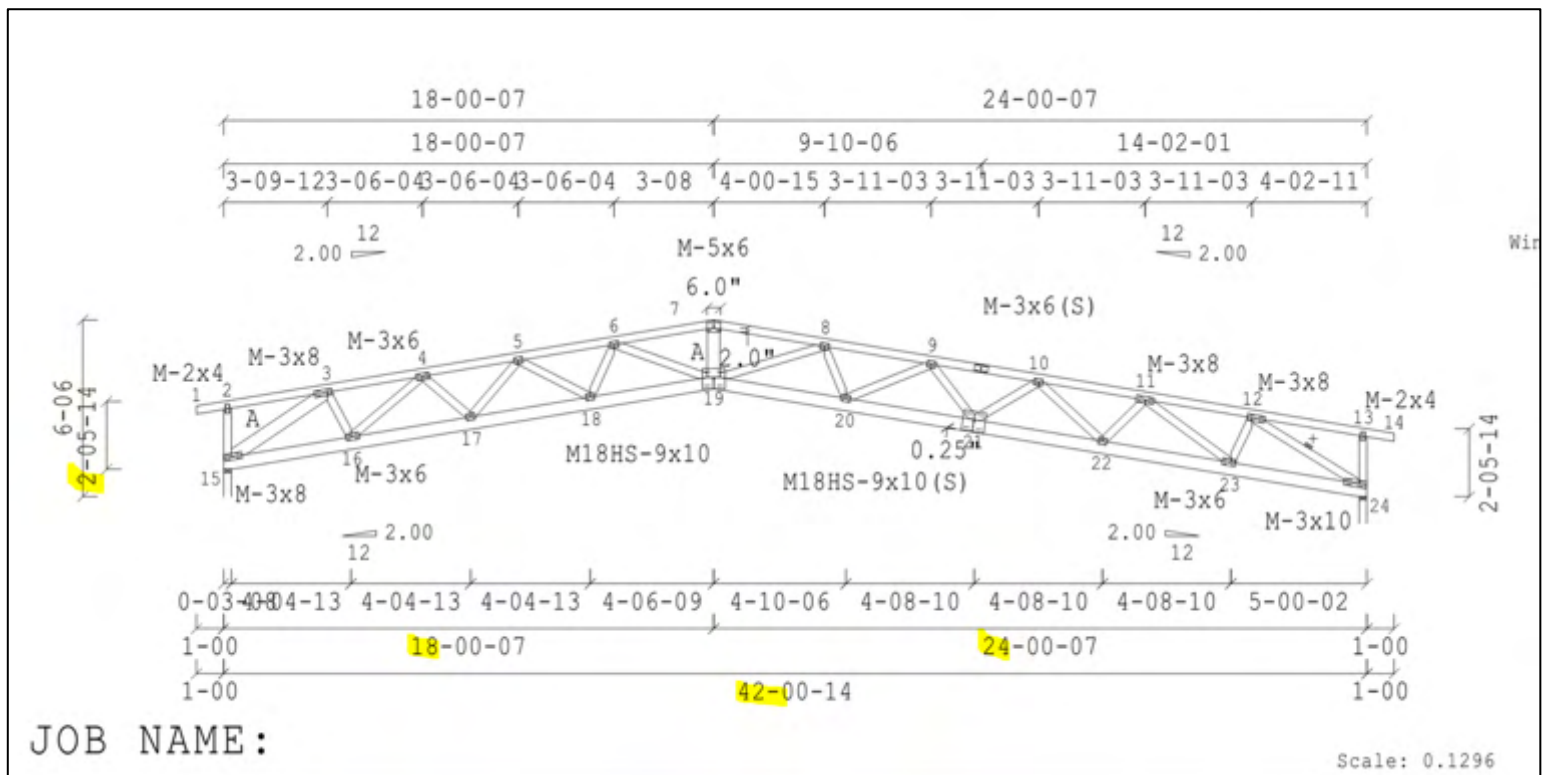
3 BR/2½ BA, 1744 ft<sup>2</sup>





# Renewal (Retrofit)

## Watson/Esparza Residence, Sunnyvale



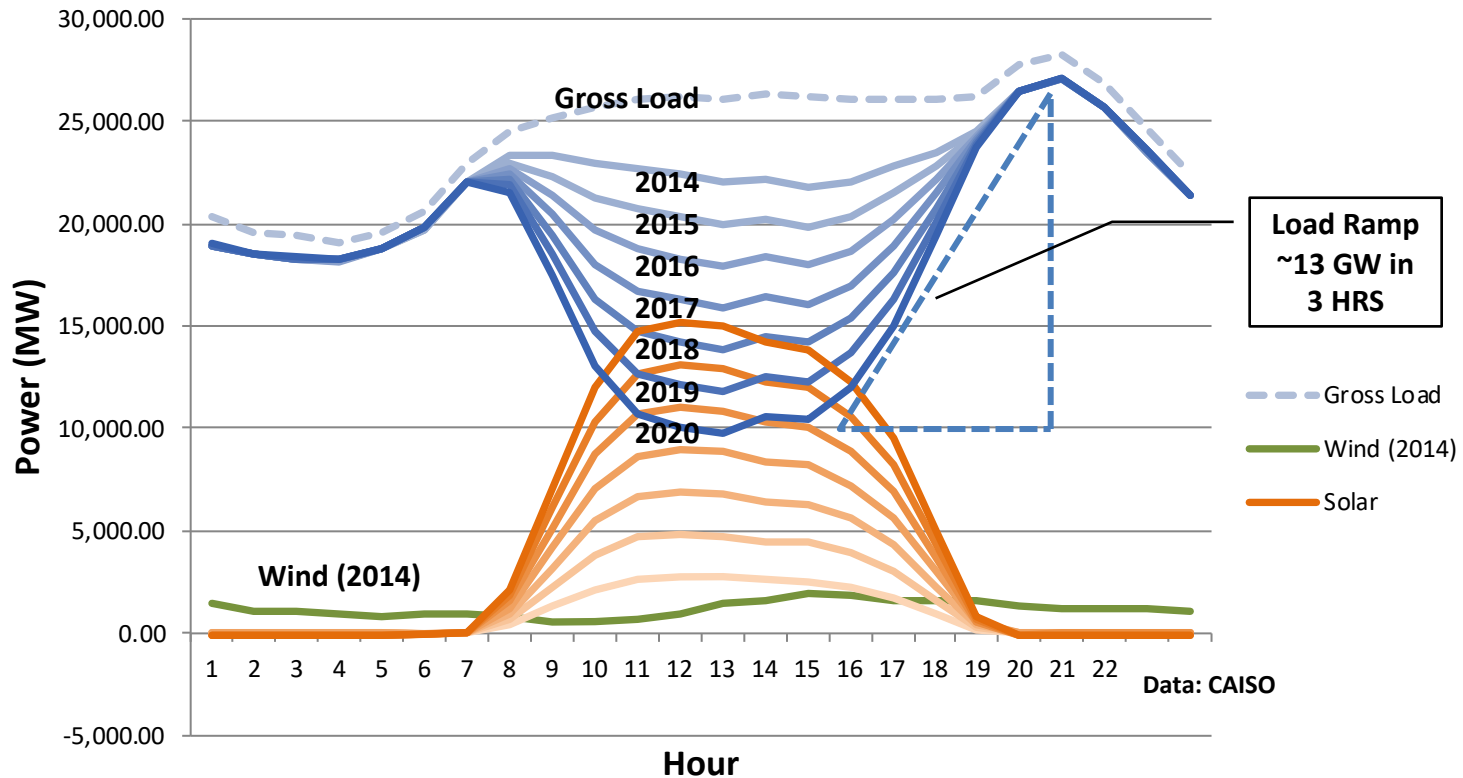
# A Renewable Grid

- Renewables are intermittent, but predictable.
- Current grid & building stock lack storage.
- Passive House provides the thermal storage and daily/seasonal demand reduction needed.
- Economic models don't properly value Passive House, YET...

# The “Duck Curve”

## Adding Solar Only, No Demand Reduction

California Grid Load (March 31)



Energy:  $13 \text{ GW} \times 3 \text{ hrs} / 2 = 19,500,000 \text{ kWh} / 10 \text{ kWh} / 70\% = 2,790,000$  Tesla 10 kW Powerwalls

Power:  $13 \text{ GW} / 2 \text{ kW} = 6,500,000$  Tesla 10 kW Powerwalls

California: 60% Renewable in 2030, Carbon Neutral by 2045, then Carbon Negative

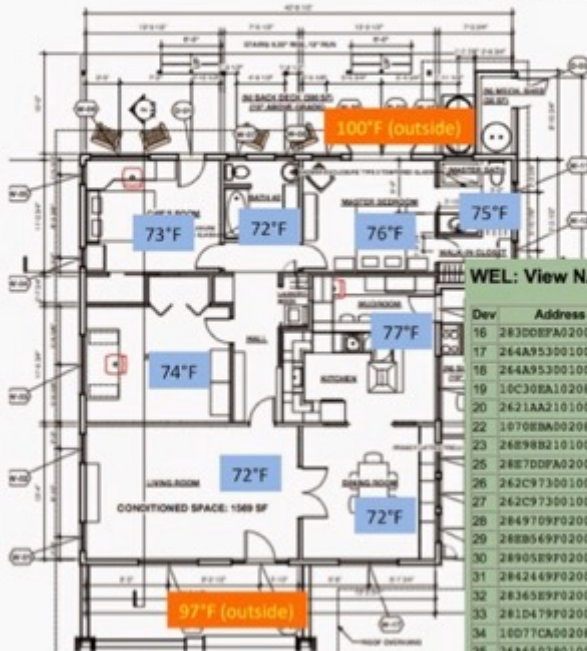
# PH Thermal Storage

## Passive House in a Heat Wave, No A/C



### Comfortable Inside During Heat Wave

example at 14-May-2014 14:35



Sensor data from WELserver

WEL: View NAMED Devices (1 Errors)

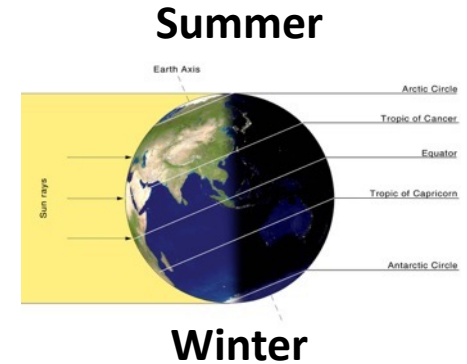
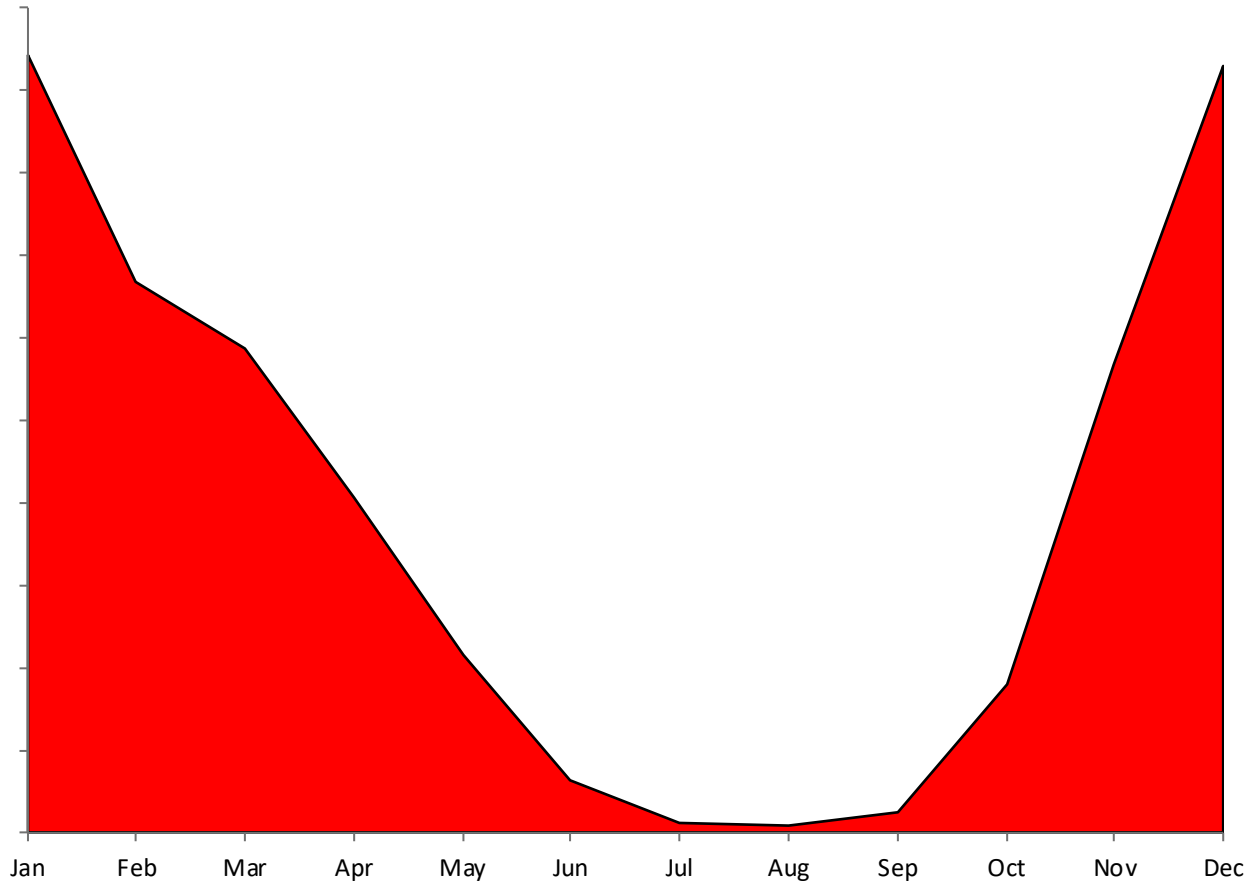
Dev	Address	Type	Name	F V	Raw	Scaled	Day: _D Month: _M
16	283DDEPA02000060	40	Master_Temp	75	24.562499	76.212501	
17	244A95300100005D	38	Master_Humid	75	1.360000	18.063599	
18	244A95300100005D	15	Master_VOC	75	4.638660	4.638660	
19	16C30EA102080080	16	MasterBath_T	75	23.750000	74.749992	
20	2421AA210100003A	38	MasterBath_H	75	1.570000	24.838196	
22	10708BA002080059	16	SDeck_Temp	75	38.249996	100.849998	
23	24E98E2101000031	38	SDeck_Humid	70	0.940000	4.514400	
25	28E7DDFA02000025	40	Mudroom_T	75	24.937498	76.887489	
26	242C9730010000A7	38	Mudroom_H	75	1.640000	27.096397	
27	242C9730010000A7	15	Mudroom_VOC	75	8.544900	8.544900	
28	2849709F020000A4	40	MechRoom_Temp	75	40.749996	105.349998	
29	2488569F020000F2	40	Hallway_Bath_T	75	22.499998	72.499992	
30	24905E9F020000AC	40	Dining_Room_T	75	22.499998	72.499992	
31	2842449F020000C7	40	Front_Porch_T	75	35.874996	96.574989	
32	28365E9F02000042	40	Chie's_Room_T	75	22.749998	72.949989	
33	281D479F02000083	40	Living_Room_T	75	22.374998	72.275001	
34	16D77CA002080066	16	Kurt's_Room_T	75	23.062498	73.512489	
35	24A4502801000000	38	Kurt's_Room_H	75	1.490000	22.257393	

1-Wire Status = Devices Found

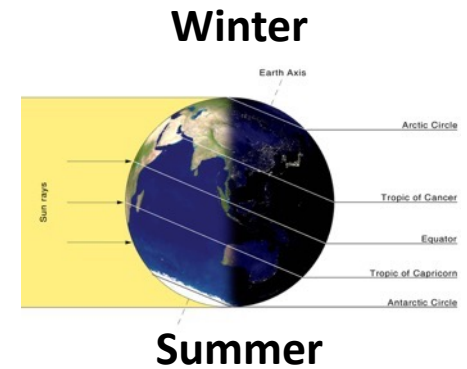
Midori Haus, Santa Cruz  
[www.midorihaus.com](http://www.midorihaus.com)

# Winter Heating Demand

“The Only Curve that Matters”

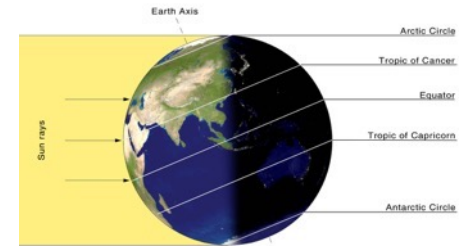
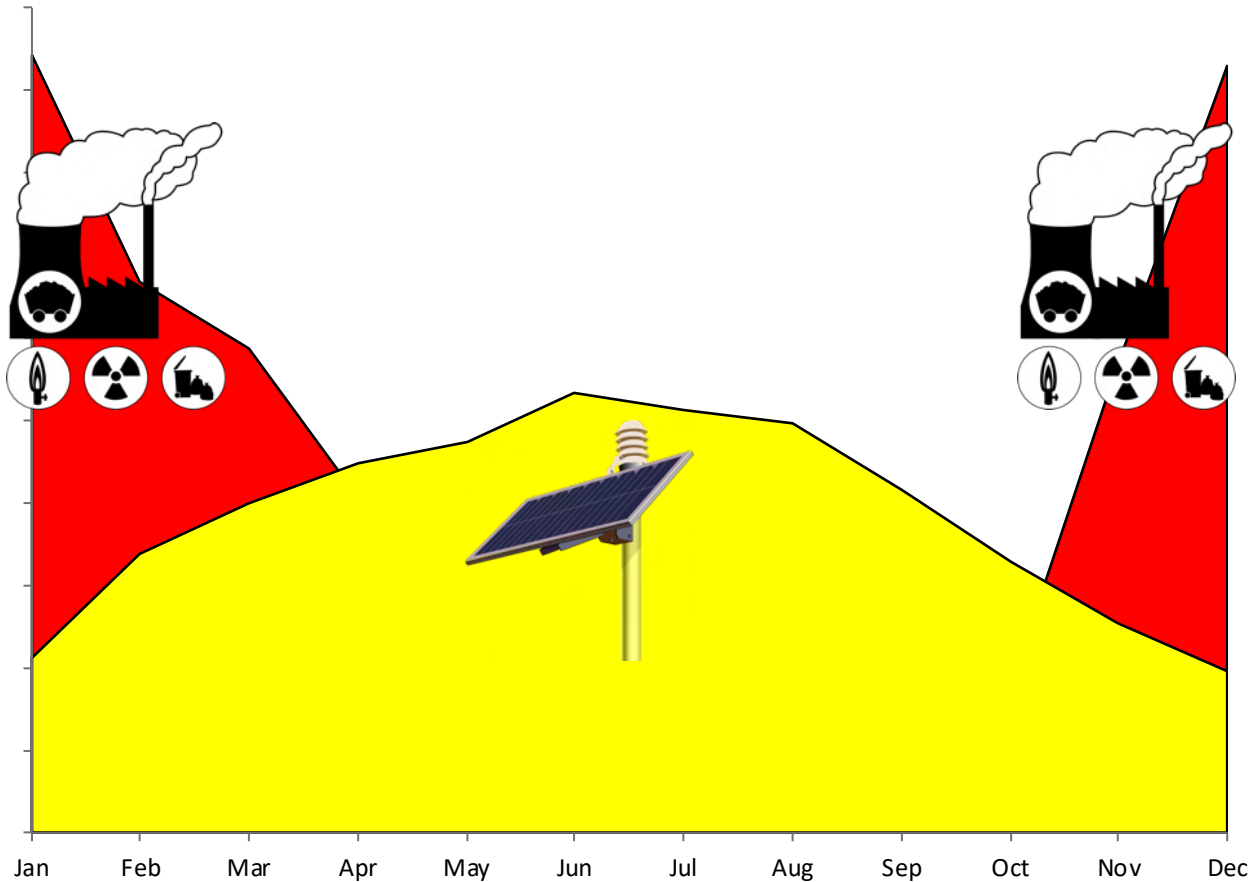


■ Heating Demand



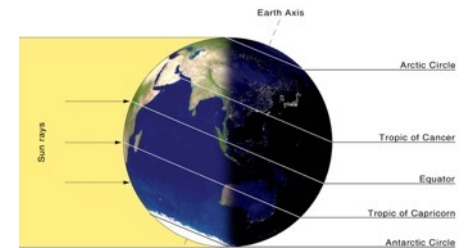
# Winter Heating Demand

“The Only Curve that Matters”



■ Heating Demand  
■ Solar

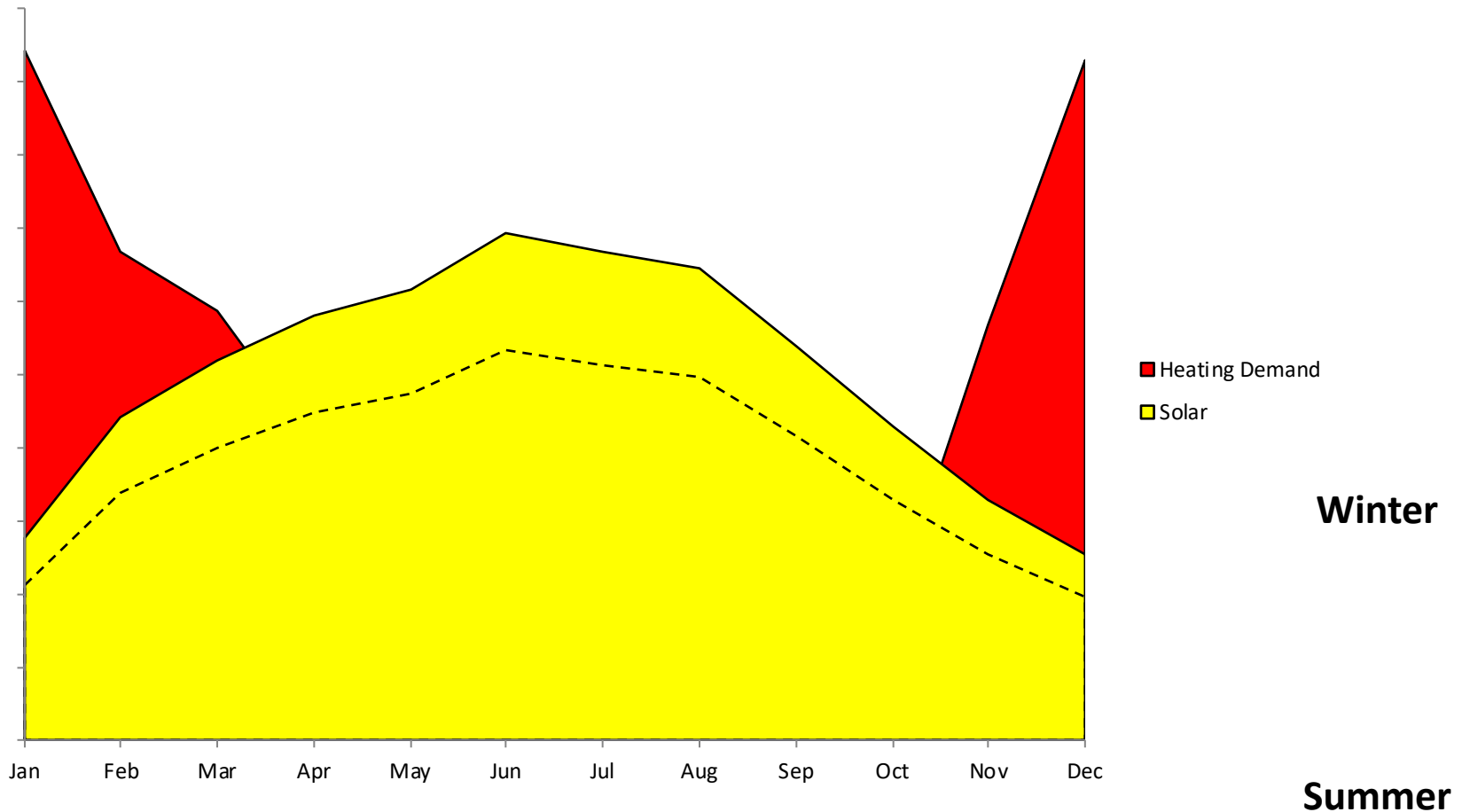
Winter



Summer

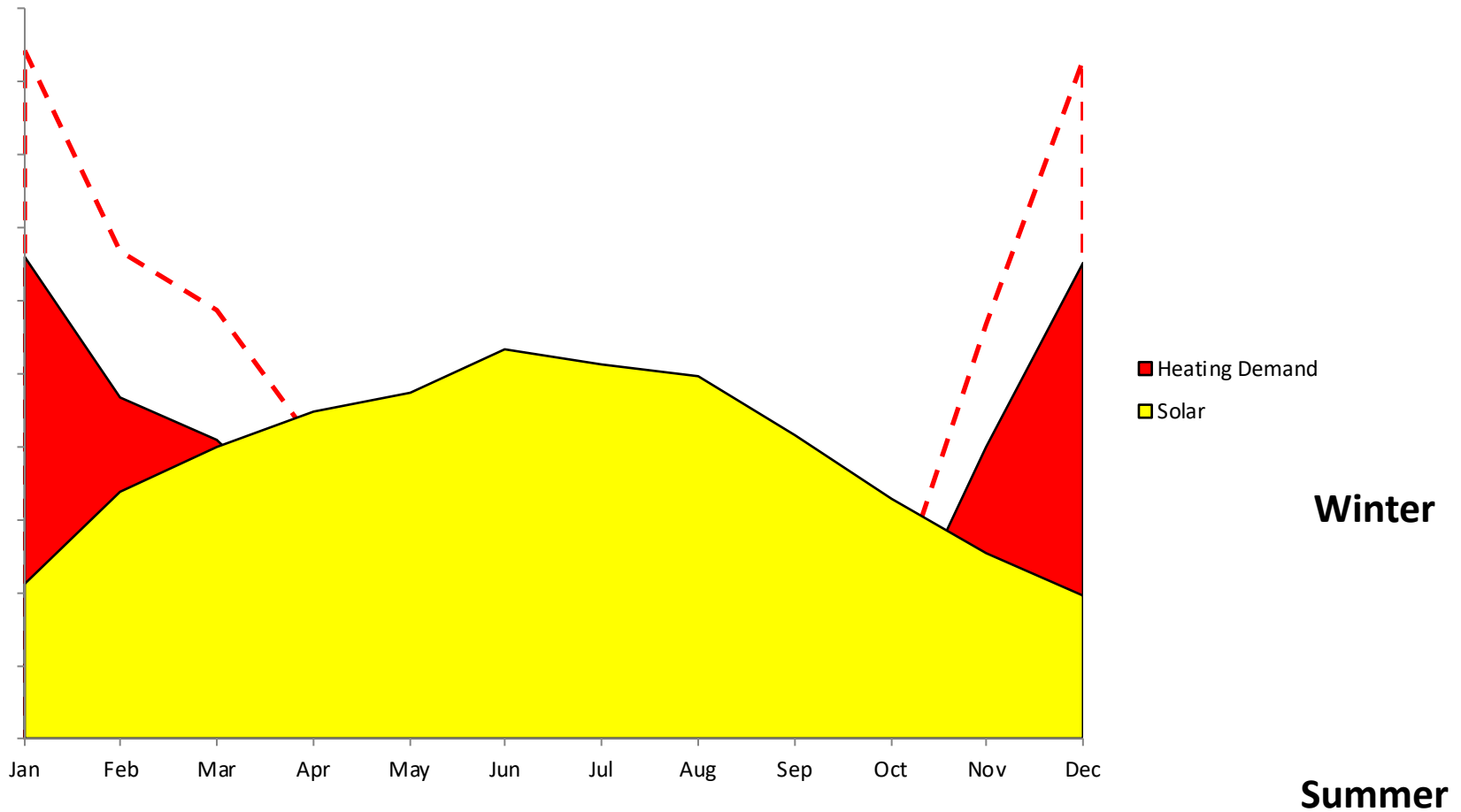
# Winter Heating Demand

“The Only Curve that Matters”



# Winter Heating Demand

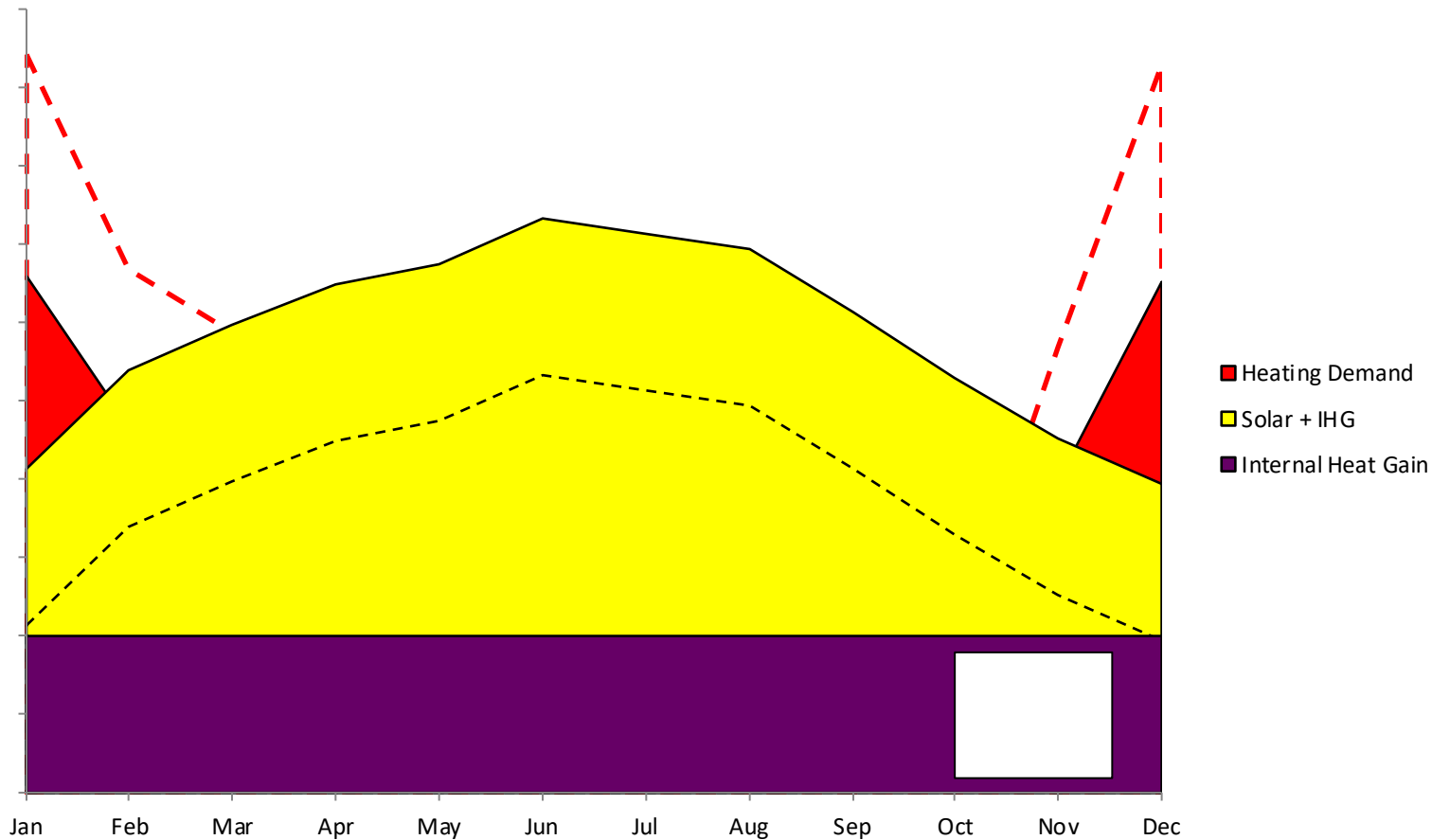
“The Only Curve that Matters”





# Winter Heating Demand

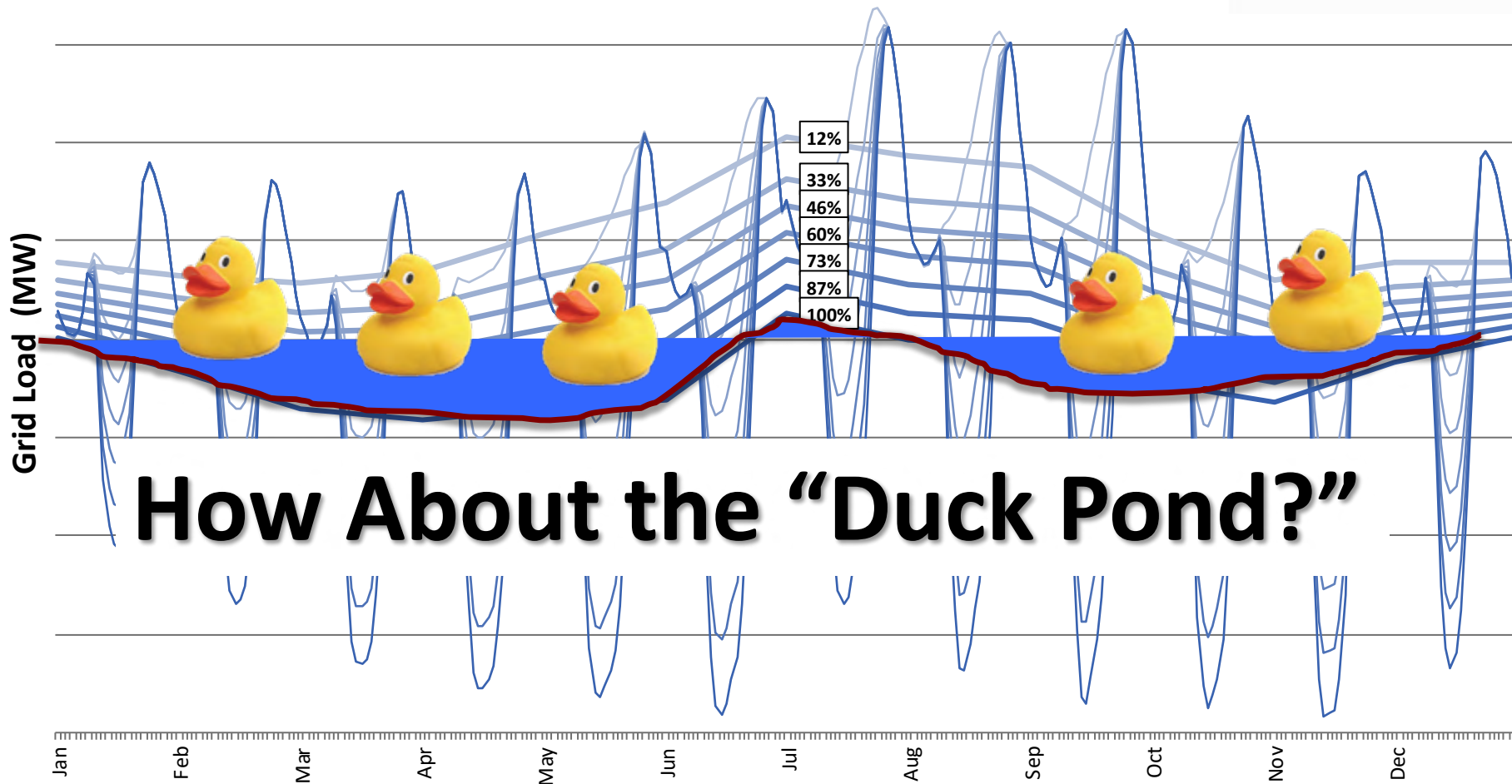
“The Only Curve that Matters”



# Don't Like the Duck?

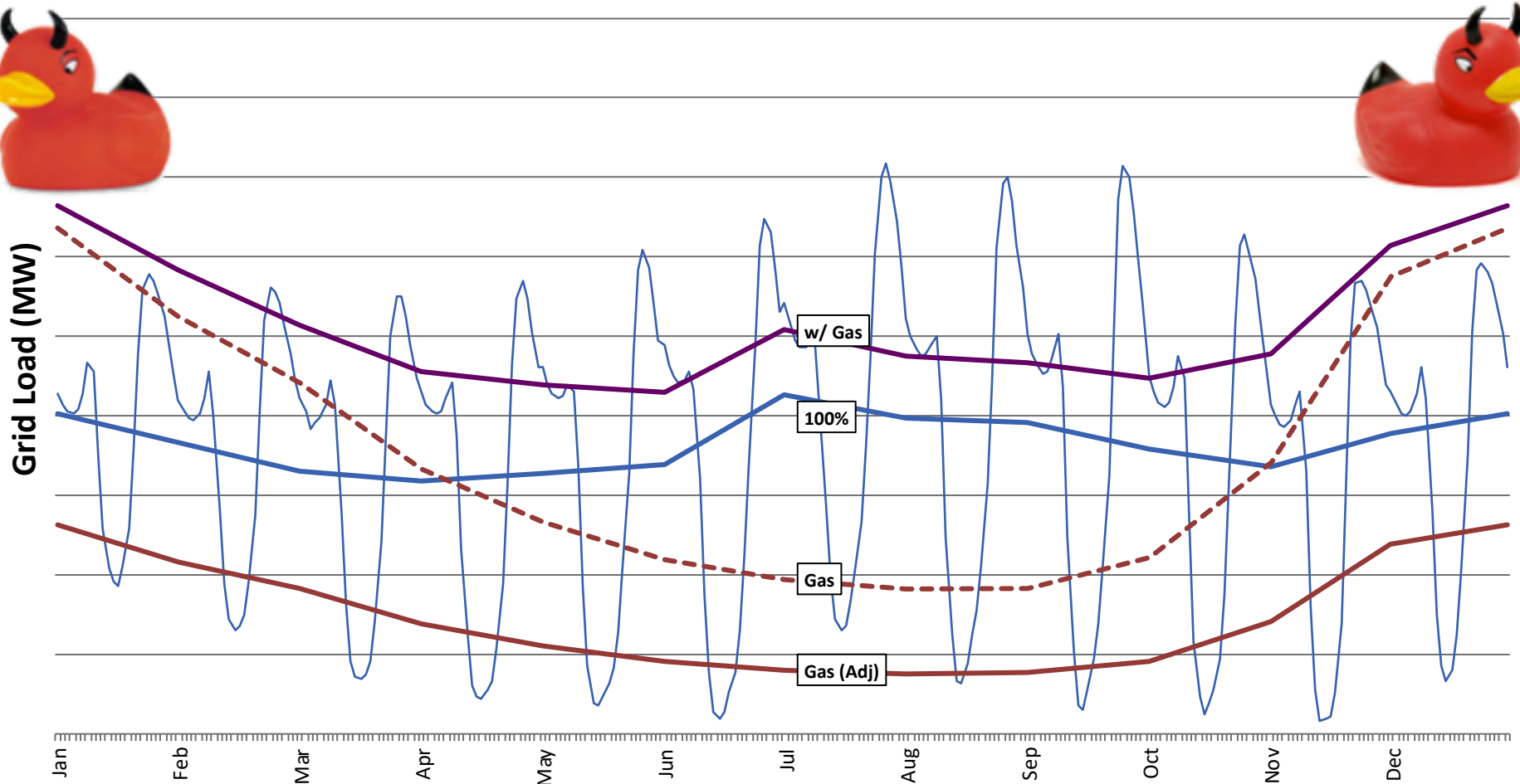


Typical Daily Grid Load vs. % Solar Energy



# What About Natural Gas?

Monthly CA Grid Load vs. Solar %

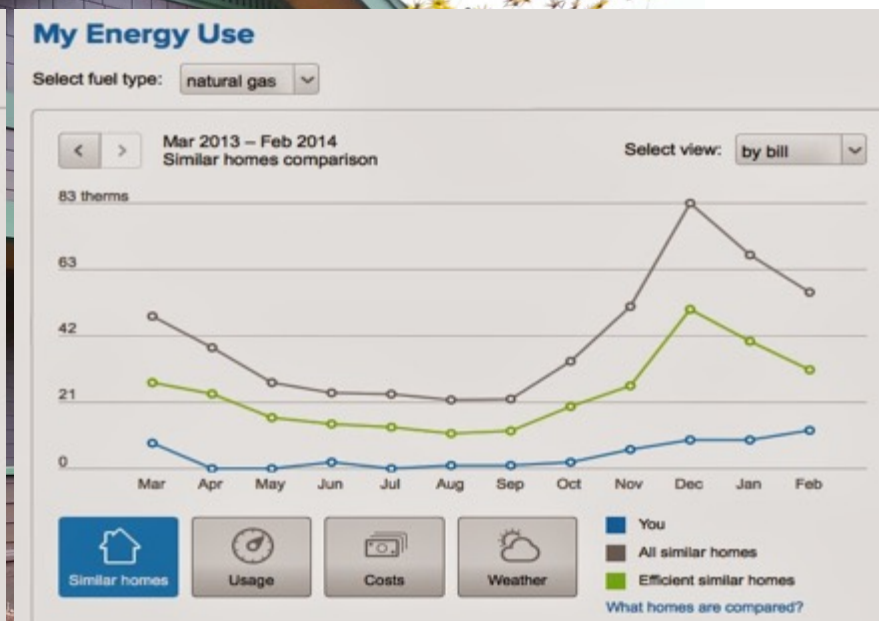
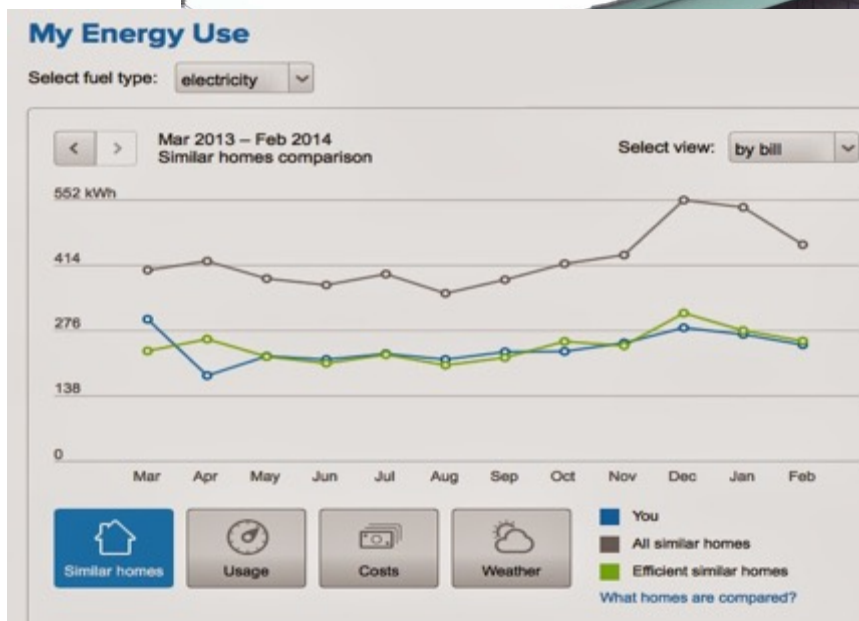


$$\text{CA Res. Gas Use}_{\text{MONTHLY(1989-2016)}} / 720 \text{ hrs/month} = \text{Gas Load}$$

$$\text{Gas Load} \times (88\% / 3.0_{\text{COP}} + 12\%) = \text{Adjusted Gas Load}$$

# Proof in Practice:

## Passive House Seasonal Energy Use.



[www.midorihaus.com](http://www.midorihaus.com)

**2869 kWh Elec. + 50 Therms (1,465 kWh) Nat. Gas = 4,334 kWh (before PV!)**

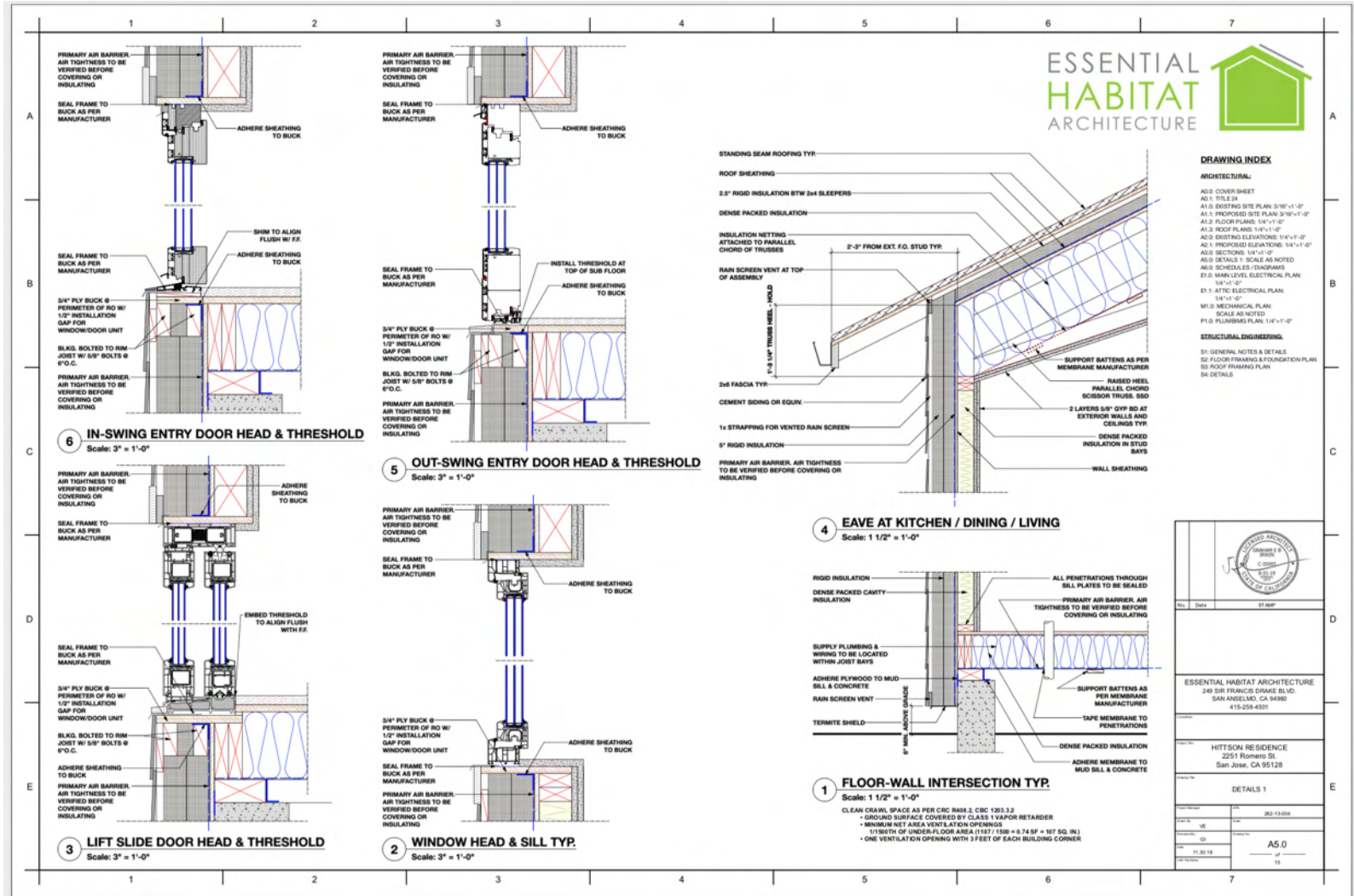
**Before Retrofit 21,928 kWh/yr, Similar CA Home 19,596 kWh/yr**

# Toward Wider Adoption

- Build public awareness/acceptance
- Deliver predictable projects to clients
- Construction is localized (max ~1 hr. radius)
- Enable existing construction industry!
- Prefab & panelized? Every chance we get!

# 4D Details

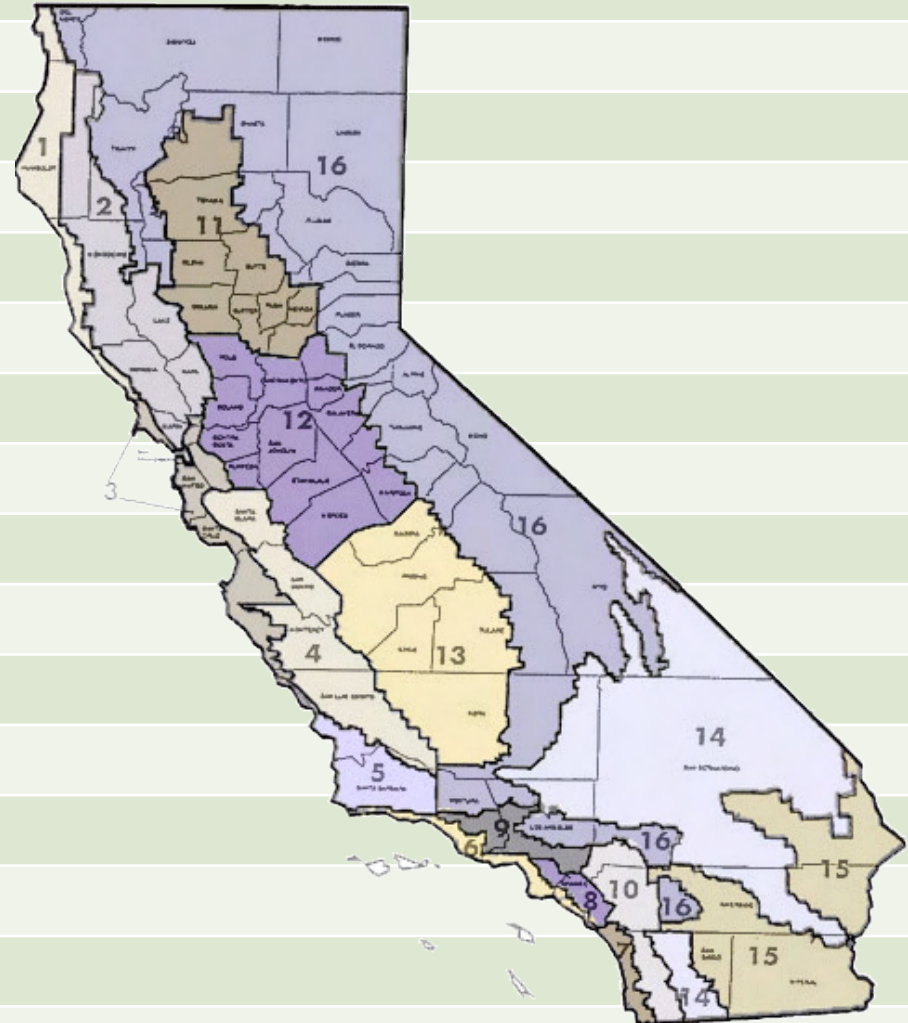
## Add Sequencing for Air Sealing & Testing!



# Wider Adoption: PH vs. Code

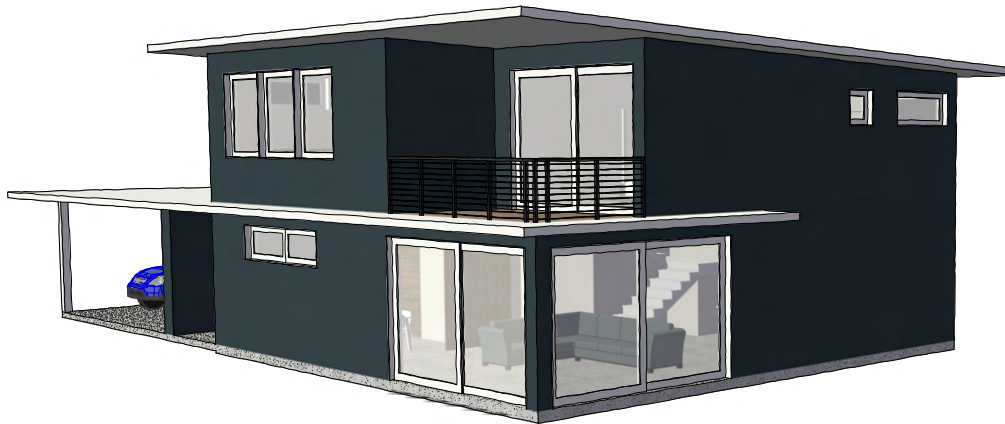


Location	# Passive Houses = 1 Code House, (🏠) = w/ Optional Heat Recovery
01 Arcata	🏠🏠🏠🏠
02 Santa Rosa	🏠🏠🏠🏠
03 Oakland	🏠🏠
04 San Jose	🏠🏠
05 Santa Maria	🏠🏠
06 Torrance	🏠🏠(🏠)
07 San Diego	🏠🏠🏠(🏠🏠🏠)
08 Fullerton	🏠🏠🏠(🏠)
09 Burbank	🏠🏠🏠(🏠)
10 Riverside	🏠🏠(🏠)
11 Red Bluff	🏠🏠🏠🏠🏠
12 Sacramento	🏠🏠🏠🏠🏠🏠
13 Fresno	🏠🏠🏠🏠🏠
14 Palmdale	🏠🏠🏠🏠🏠🏠
15 Palm Springs	🏠🏠🏠
16 Blue Canyon	🏠🏠🏠🏠🏠🏠



# Toward Wider Adoption

## “Pocket Production” Passive Houses



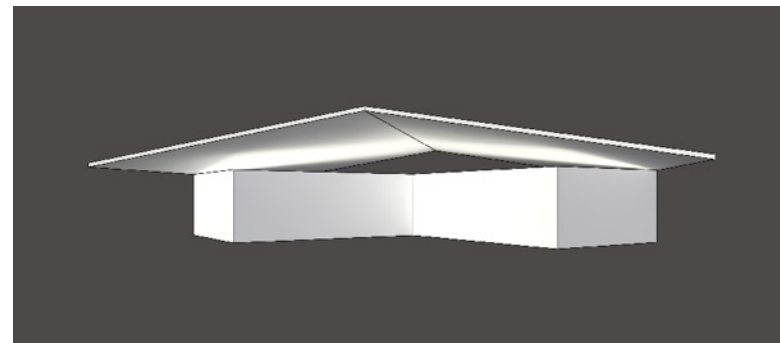
**“The Healdsburg”**

2790 SF (4 BR, 3-1/2 BA)



**“The Mendocino”**

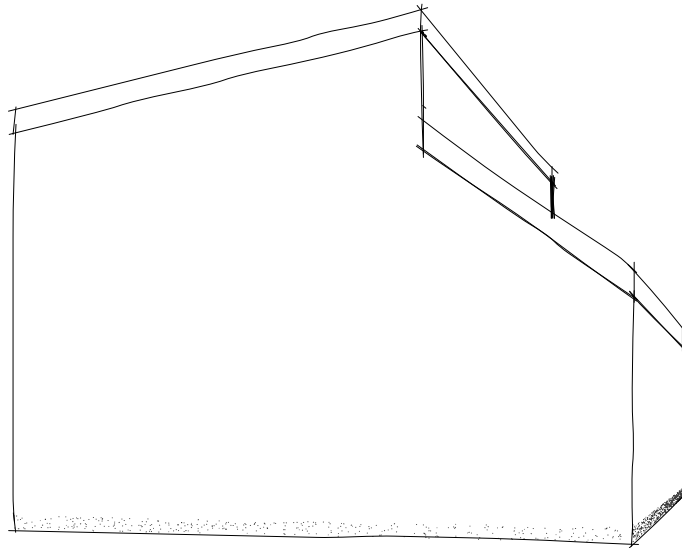
2270 SF (4 BR, 3-1/2 BA)



**“The Mojave”**

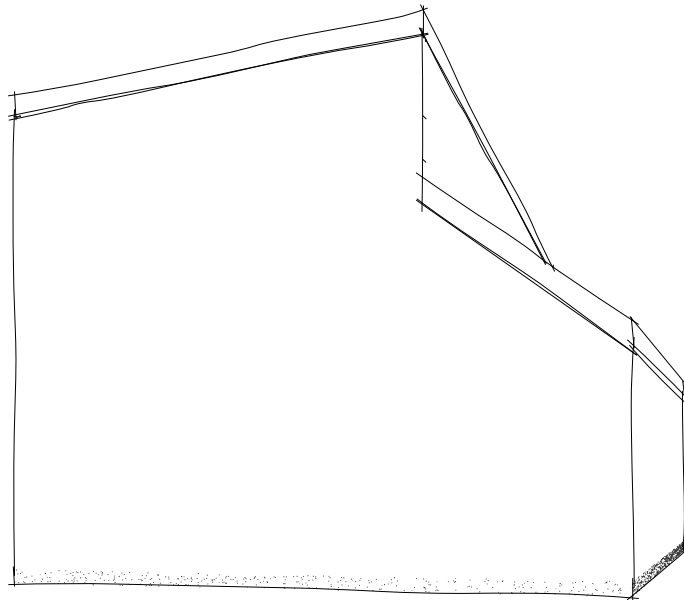


# “The Mendocino” 2270 ft<sup>2</sup> (4 BR, 3½ BA)



Initial Sketch

# “The Mendocino” 2270 ft<sup>2</sup> (4 BR, 3½ BA)



45° Rotated Ridge

# **“The Mendocino” 2270 ft<sup>2</sup> (4 BR, 3½ BA)**



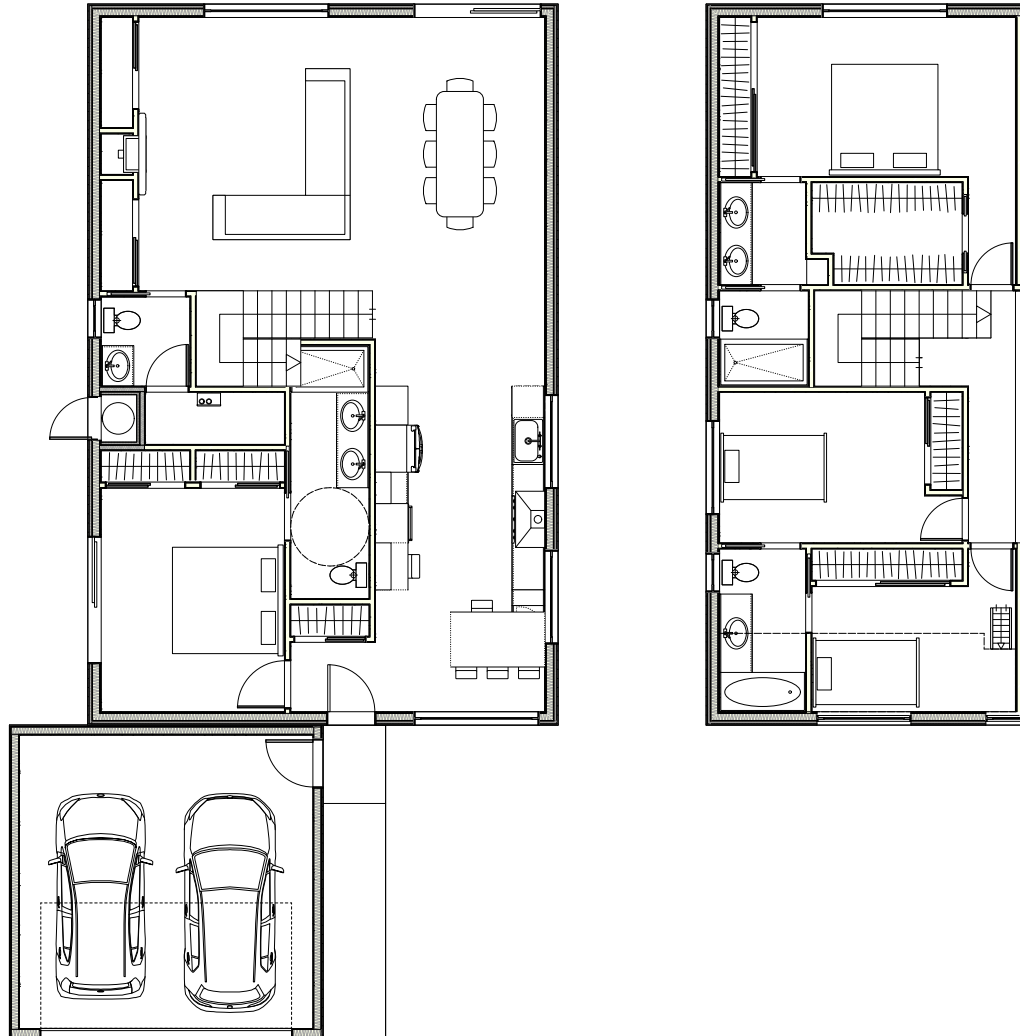
**Unconditioned Space (Garage) for Detail**

# “The Mendocino” 2270 ft<sup>2</sup> (4 BR, 3½ BA)



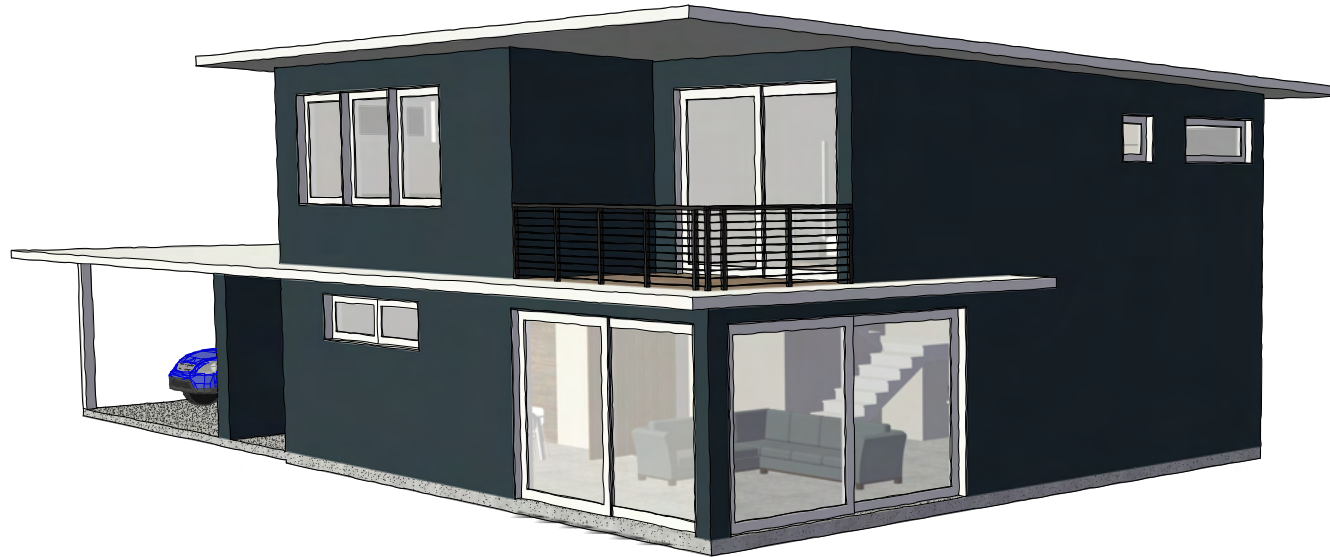
Streetscape

# “The Mendocino” 2270 ft<sup>2</sup> (4 BR, 3½ BA)



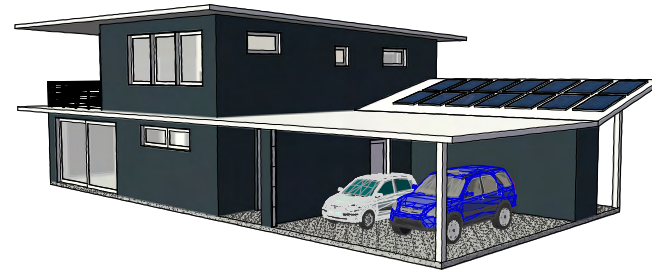
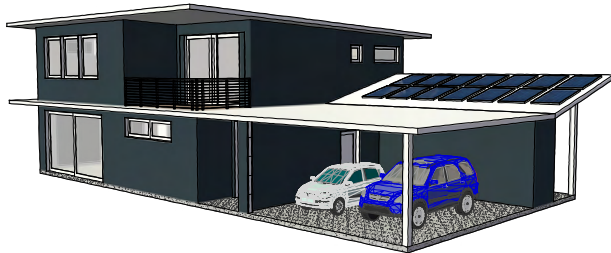
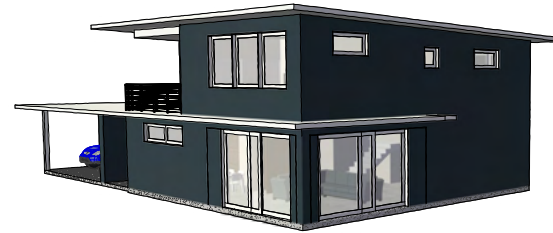
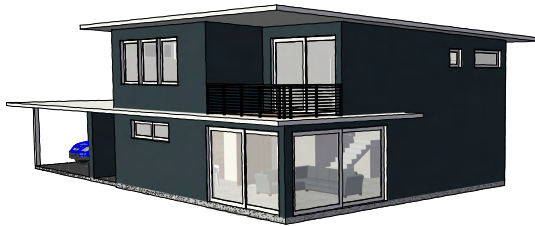
# **“The Healdsburg” 2790 ft<sup>2</sup> (4 BR, 3 ½ BA)**

**1 Design, 4 Configurations (Centered Stairs)**



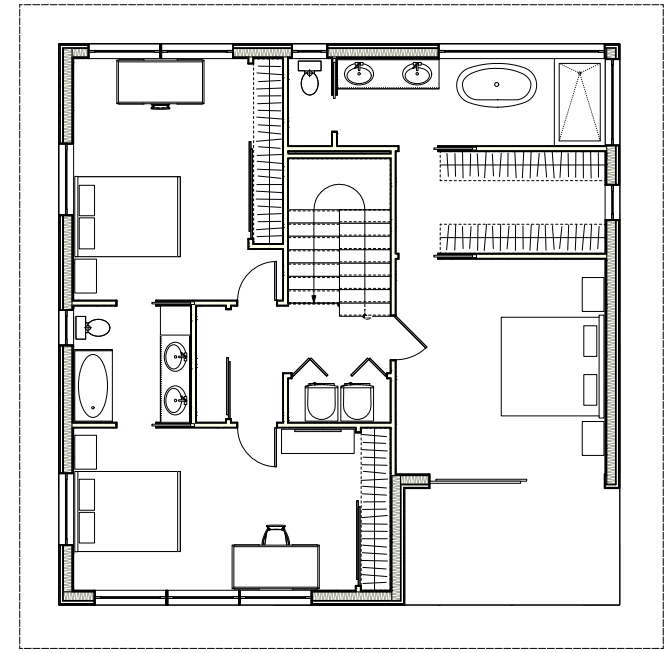
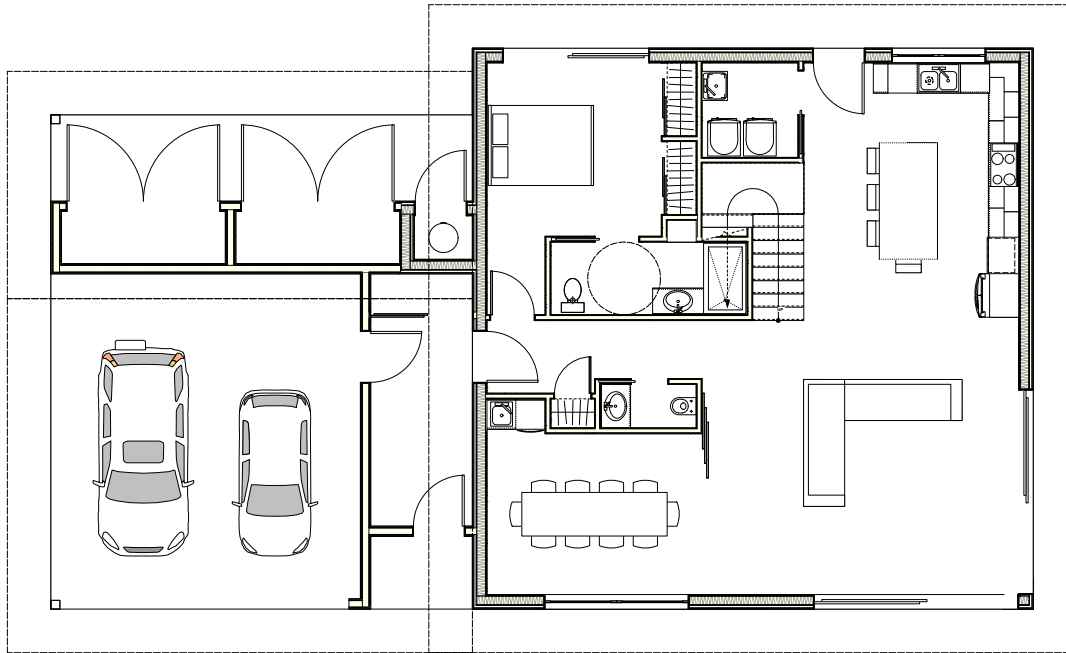
# “The Healdsburg” 2790 ft<sup>2</sup> (4 BR, 3 ½ BA)

1 Design, 4 Configurations (Centered Stairs)



# “The Healdsburg” 2790 ft<sup>2</sup> (4 BR, 3 ½ BA)

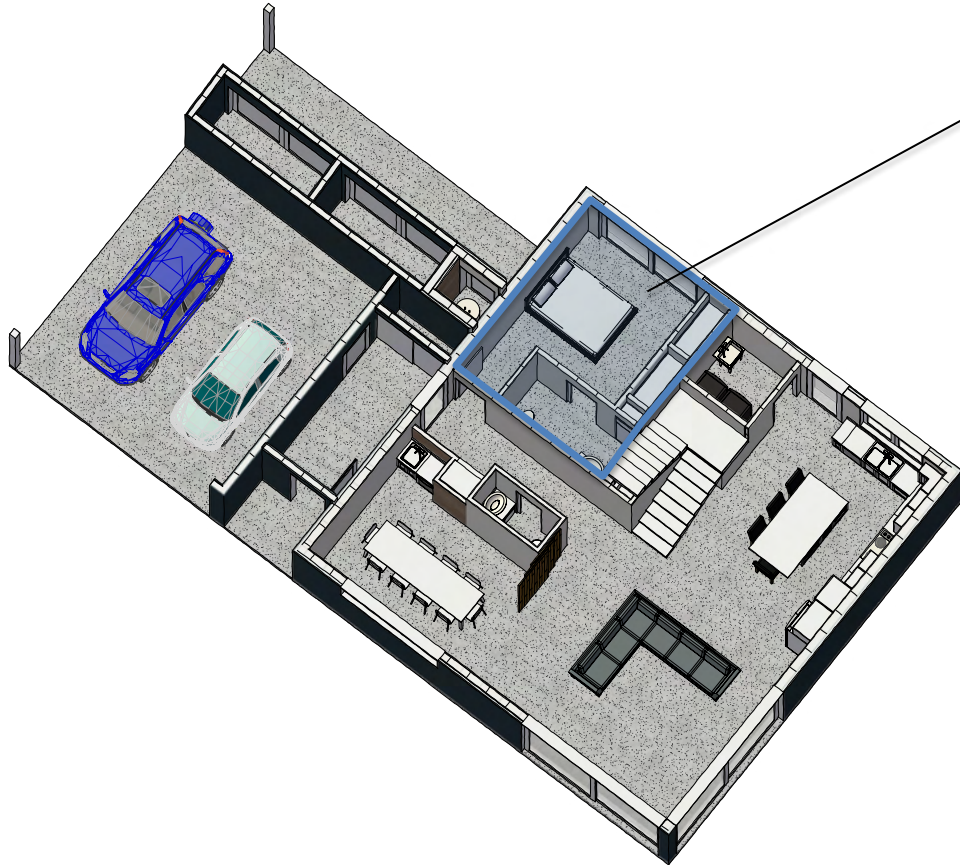
1 Design, 4 Configurations (Centered Stairs)





# Open Building

“Forever Home”

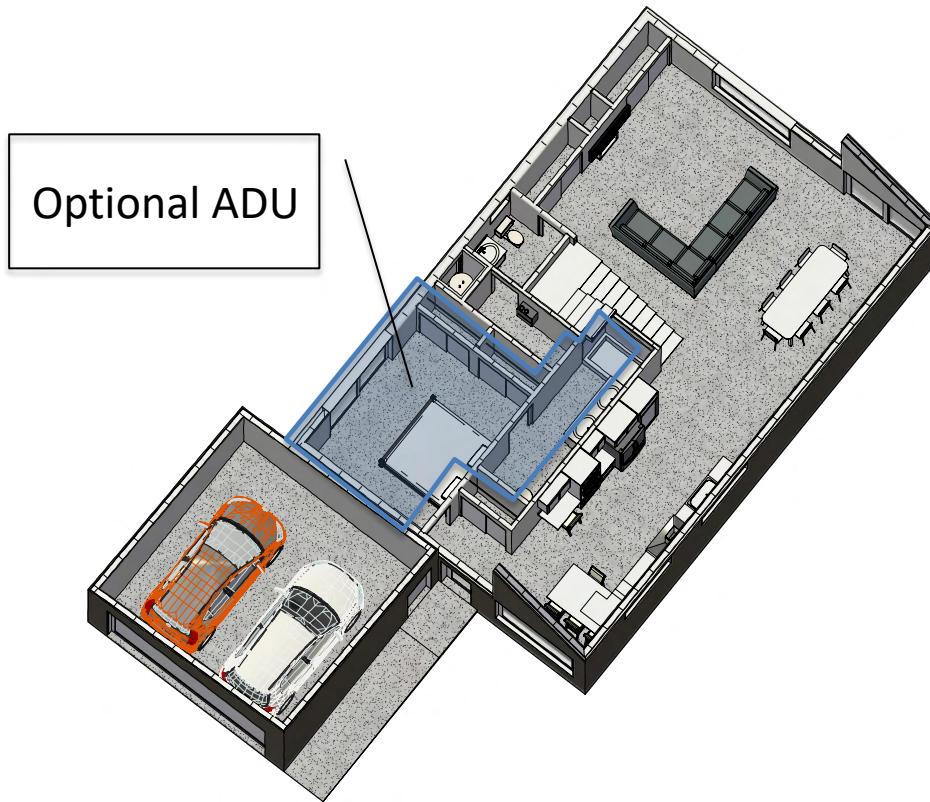


1. ADU (w/ kitchenette)
2. Guest Suite/Den
3. Accessible Master Suite

“The Healdsburg” (1<sup>st</sup> Floor)

# End of Single-Family Housing

## State of CA Zoning Mandates for ADUs



**"The Mendocino" (1<sup>st</sup> Floor)**



**In the Works: "Convertibles"**

- **Garage -> ADU**
- **Skirt Car-Centric Zoning**

# “Informed” Vernacular

Worldwide Insolation

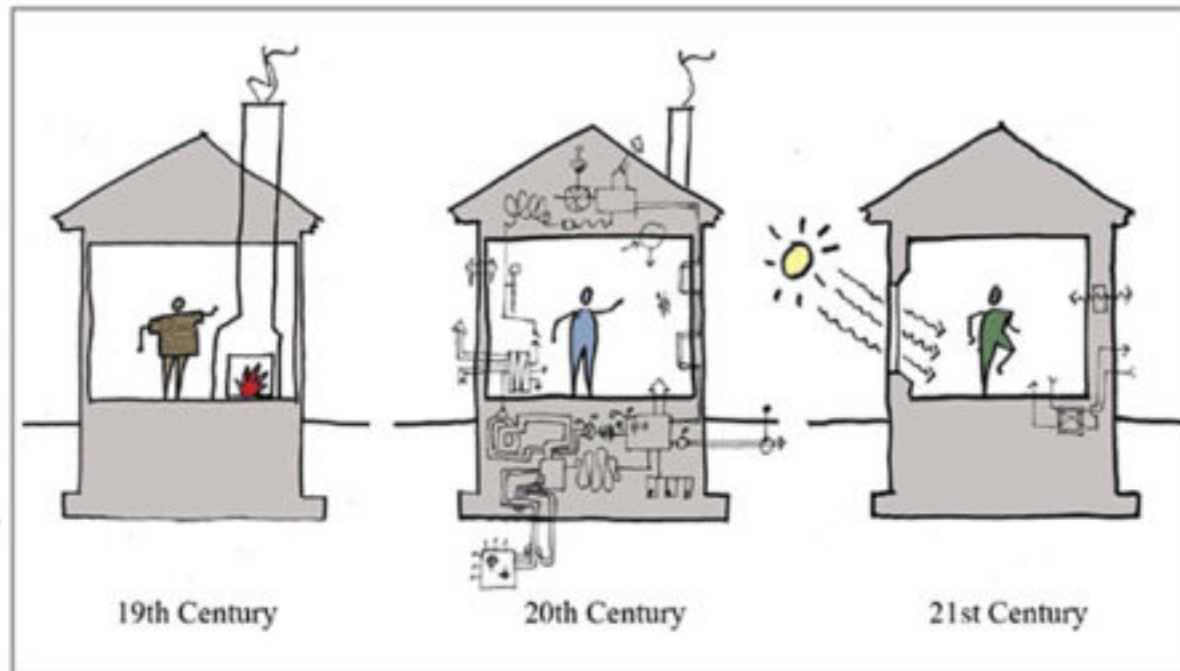
shading [shey-ding]



*Baṅglā*  
*Baṅgalo*  
Bungale  
**Bungalow**

# Good Grid Citizenship

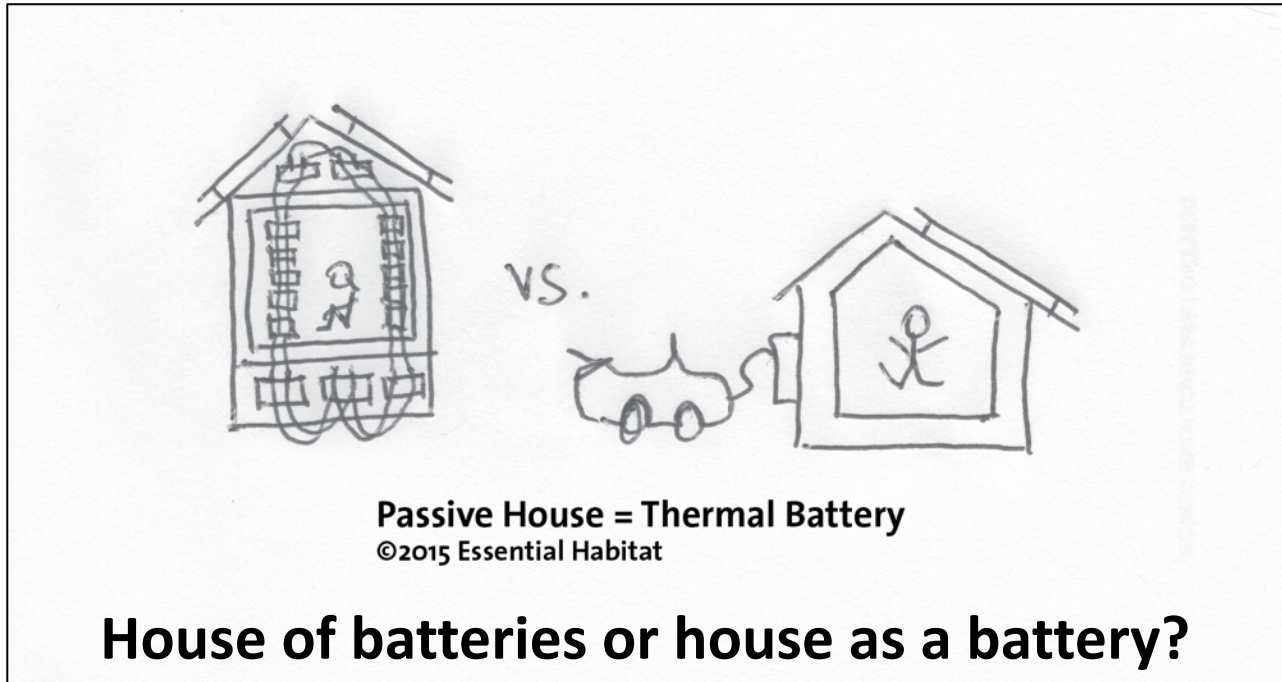
Time of Use More Valuable than Generation



*image source: Albert, Richter and Tittmann Architects*

# Good Grid Citizenship

Time of Use More Valuable than Generation



# Good Grid Citizenship

Time of Use More Valuable than Generation



**Sol-Lux Alpha, San Francisco CA**

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# Thank You! Questions?



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