DOCKETED	
Docket Number:	17-BSTD-01
Project Title:	2019 Building Energy Efficiency Standards PreRulemaking
TN #:	217417
Document Title:	Metric to recognize load shifting capacity of ultra-efficient shell buildings, such as Passive House.
Description:	N/A
Filer:	System
Organization:	Bronwyn Barry
Submitter Role:	Public
Submission Date:	5/4/2017 2:27:17 PM
Docketed Date:	5/4/2017

Comment Received From: Bronwyn Barry
Submitted On: 5/4/2017
Docket Number: 17-BSTD-01

Metric to recognize load shifting capacity of ultra-efficient shell buildings, such as Passive House.

Additional submitted attachment is included below.

PASSIVE
HOUSE
CALIFORNIA

Docket Number: 17-BSTD-01

Date: May 5th 2017

Project Title: 2019 Building Energy Efficiency Standards Pre-Rulemaking

Comment Organization: Passive House California

Address: 2875 21st Street, #4, San Francisco, CA 94110

Passive House California Proposes the Energy Design Rating (EDR) planned to verify ZNE compliance for New Residential Construction in 2020 will be supplemented with an additional metric to recognize the electric grid value of Load Shifting for Space Conditioning Demand enabled with ultra-efficient shell buildings.

Passive House California is a non-profit, member-driven organization that is focused on promoting high performance buildings and the Passive House Standard throughout California.

Passive House California appreciates the opportunity to provide feedback to the California Energy Commission concerning the 2019 Building Energy Efficiency Standards PreRulemaking. Although we agree that the commission's current ZNE strategy roadmap has significant merits, there remains concern as to whether the approach is adequately future-proofed against the statewide trends towards fuel switching, new electric loads, and an ever more severe "Duck Curve".

Passive House California acknowledges the Commission's planned Energy Efficiency Standards approach to increase High Performance Attics (HPA) to R19, to improve High Performance Walls (HPW) performance to U ~0.045, and to improve window performance to U-factor ~0.30.

Passive House California acknowledges the commission's strategy to acknowledge a building's Energy Design Rating (EDR) purely derived from its Energy Efficiency rating first, and only afterwards determine a final EDR including the building's PV array to determine ZNE compliance.

Passive House California acknowledges and appreciates the opportunity for a building to become ZNE compliant solely through its Energy Efficiency derived EDR.

Notwithstanding the abovementioned strengths and merits, the 2019 Building Energy Efficiency Standards will set a design precedent for tens of thousands of new CA residential structures and stimulate the All-Electric Home (AEH) approach.

Fuel switching away from propane and natural gas are important AEH outcomes for CA and are supported by PHCA.

Yet increased AEH uptake risks worsening the "Duck Curve" paradox since early evening electric loads cannot be met reliably while solar generation is diminishing during those same hours of the day, especially with the increased adoption of Electric Vehicles (EVs) and electrification of DHW loads in an AEH design approach. It would be illogical to assume otherwise. As the staff reports cites, the expense of chemical battery energy storage is high and comes with increased cost implications for the retail price of renewable electricity. The 24hr load profile shift with AEH worsens the already problematic features of the "Duck Curve" (see Figure 1). Fortunately, stimulating the greater adoption of ultra-efficient shell building approaches such a Passive House through future California Building Energy Standards offers a cost effective way to alleviate these concerns over the evening ramp feature of the "Duck Curve".

The Passive House building approach provides a uniquely high performance building shell suitable to achieve significant Demand Shifting of space cooling and space heating energy demand. This means the ability to flatten the already extreme and steepening slopes of the CAISO statewide demand curve through a radical shift in the 24 load shape deriving from CA's built environment. In this case, a residential structure in Fresno CA CZ13 in August could be precooled using midday solar surplus and maintain comfortable interior temperature throughput the evening's high exterior temperatures till the next day, just as a residential structure in Bishop CA CZ16 could be pre-heated midday in Dec using surplus midday solar and maintain a comfortable interior temperature throughout the evening's low exterior temperatures till the next day.

Ultra-high performance shell buildings enjoy not only very low and very level electric demand curves (see Figure 2) but can also have considerable resilience to multi-day heat waves (see figure 3) without resorting to mechanical air conditioning. Winter space heating energy demand is also considerably flattened, even compared to other building energy efficiency approaches (see Figure 4). Space conditioning loads in ultra-efficient shell buildings can be shifted, thus re-shaping their energy consumption to coincide with peak hours of renewable generation (See Figure 5).

The CA Energy Commission's continued (exclusive) use of E3's TDV metric to determine energy efficiency measure cost efficacy risks policies that may contribute to load patterns in CA's built environment that will precipitate an electric grid catastrophe. This could necessitate expensive stop-gap measures including unplanned chemical battery energy storage and unplanned Transmission infrastructure to simultaneously achieve lasting electric grid stability while also meeting aggressive RPS targets.

A new metric to acknowledge the Demand Shifting potential of ultra-high performance shell buildings is critical to the development of a Future-Proof ZNE policy for California's built environment that is *both* healthy for building owner rate-payers *and* CA's grid infrastructure reliability.

One approach to better reflect the value of Demand Shifting is to augment the modeled EDR with the Building Time Constant or tau (τ) being the defined as [Building Thermal Mass/ Whole House Conductance] and having units [(Wh/K)/(W/ΔK)] (see Figure 6). For Passive House structures the value of tau (τ) can range between 120 and 720 hrs. Much of the computational input to calculate (τ) are already inputs to prevailing building energy modeling software tools so the extent and cost of the software feature request would be modest.

Perhaps one of the most compelling economic advantages of ultra-efficient shell buildings is their ability to glove-fit planned CA TOU electric rate structures. Through Demand Shifting of Space Conditioning requirements, either heating or cooling, CA homeowners' return on investment (ROI) on shell Energy Efficiency features will increase due to improved access to lower midday electric rates proposed in 2019 TOU tariff structures. The computed Net Present Value (NPV) for those shell features increases for the same reasons, i.e. Net Present Value (NPV) of Energy Efficiency measures is not merely derived from avoided kWh electric energy use due to curtailment, but also includes improved access to lower rates for energy consumed during hours of the day favorable to renewable generation.

We look forward to the Commission's feedback on this issue.

Sincerely

Bronwyn Barry, Board President

Passive House California

Figure 1 OPower 24hr Aggregate Residential Energy Use Data

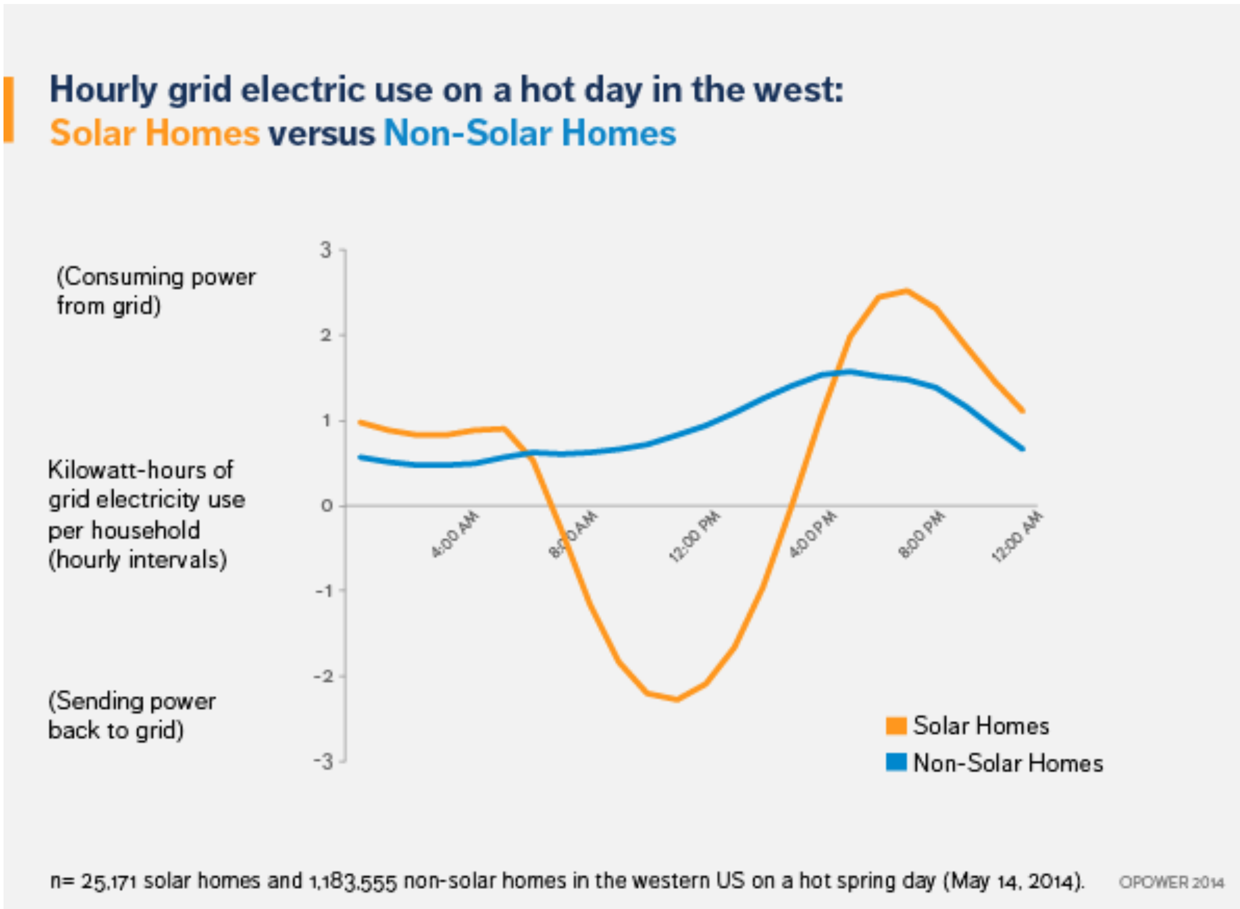


Figure 2 Passive House in Santa Cruz CZ 3, Hourly Electric Energy without Load Shifting

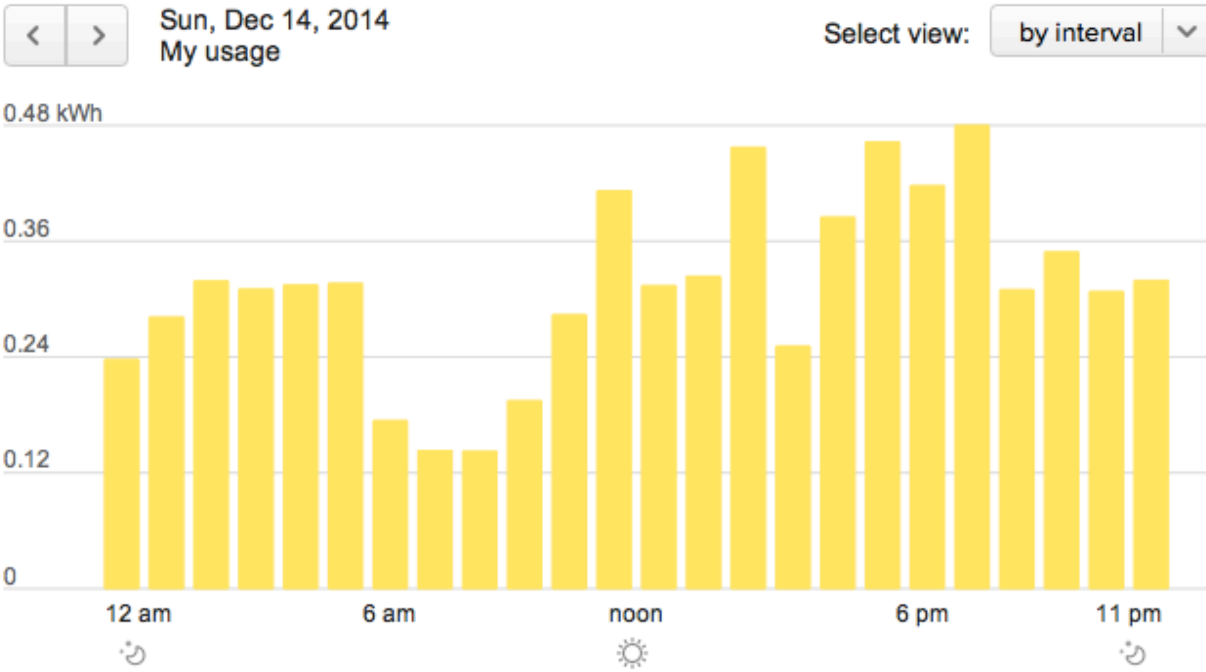
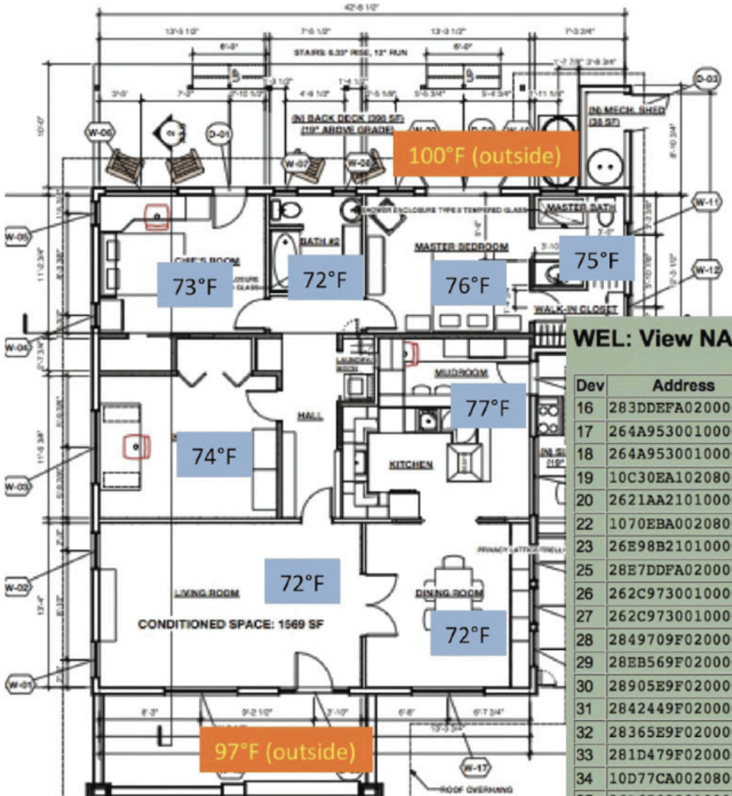
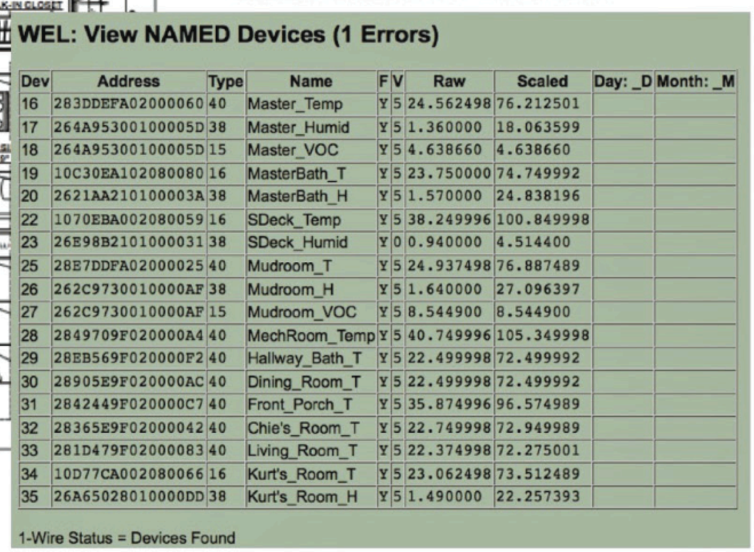


Figure 3 Passive House Retrofit Santa Cruz CA CZ3 (4 Day Heat Wave)

No active Air Conditioning



Sensor data from WELserver



WEL: View NAMED Devices (1 Errors)

Dev	Address	Type	Name	F	V	Raw	Scaled	Day: _D	Month: _M
16	283DDEFA02000060	40	Master_Temp	Y	5	24.562498	76.212501		
17	264A95300100005D	38	Master_Humid	Y	5	1.360000	18.063599		
18	264A95300100005D	15	Master_VOC	Y	5	4.638660	4.638660		
19	10C30EA102080080	16	MasterBath_T	Y	5	23.750000	74.749992		
20	2621AA210100003A	38	MasterBath_H	Y	5	1.570000	24.838196		
22	1070EBA002080059	16	SDeck_Temp	Y	5	38.249996	100.849998		
23	26E98B2101000031	38	SDeck_Humid	Y	0	0.940000	4.514400		
25	28E7DDFA02000025	40	Mudroom_T	Y	5	24.937498	76.887489		
26	262C9730010000AF	38	Mudroom_H	Y	5	1.640000	27.096397		
27	262C9730010000AF	15	Mudroom_VOC	Y	5	8.544900	8.544900		
28	2849709F020000A4	40	MechRoom_Temp	Y	5	40.749996	105.349998		
29	28EB569F020000F2	40	Hallway_Bath_T	Y	5	22.499998	72.499992		
30	28905E9F020000AC	40	Dining_Room_T	Y	5	22.499998	72.499992		
31	2842449F020000C7	40	Front_Porch_T	Y	5	35.874996	96.574989		
32	28365E9F02000042	40	Chie's_Room_T	Y	5	22.749998	72.949989		
33	281D479F02000083	40	Living_Room_T	Y	5	22.374998	72.275001		
34	10D77CA002080066	16	Kurt's_Room_T	Y	5	23.062498	73.512489		
35	26A65028010000DD	38	Kurt's_Room_H	Y	5	1.490000	22.257393		

1-Wire Status = Devices Found

Figure 4 Passive House in Santa Cruz CA CZ3, 12-Month Space Heating Energy w/

Solar Thermal Hydronic in-line with HRV + NG Boiler as backup

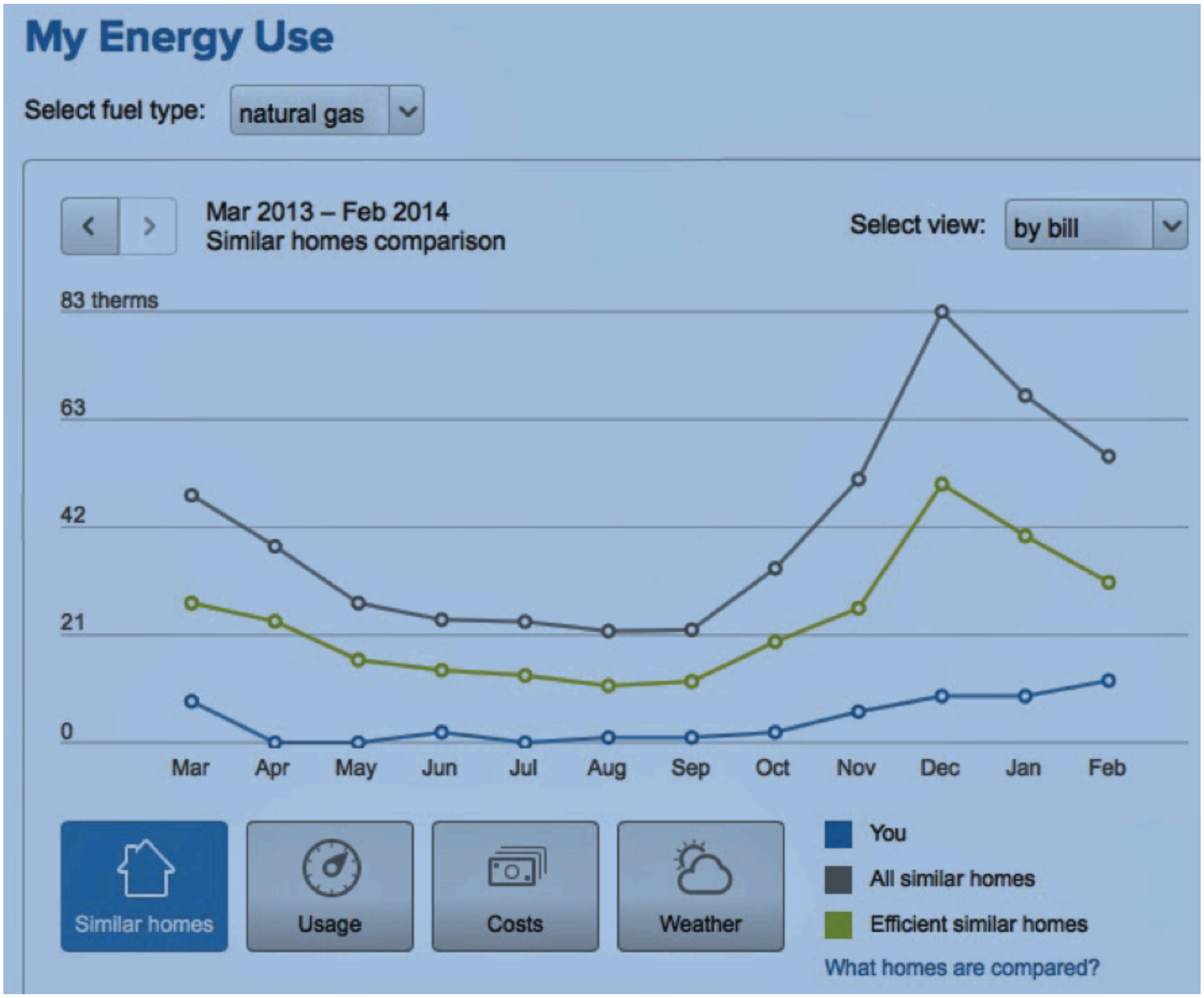


Figure 5 Passive House Hourly Electric Energy with (simulated) Demand Response event as midday Demand Shift of 1.5kW Air Conditioning load for 1.25 hr duration (NOTE: the Y-axis is re-scaled compared to Figure 2)

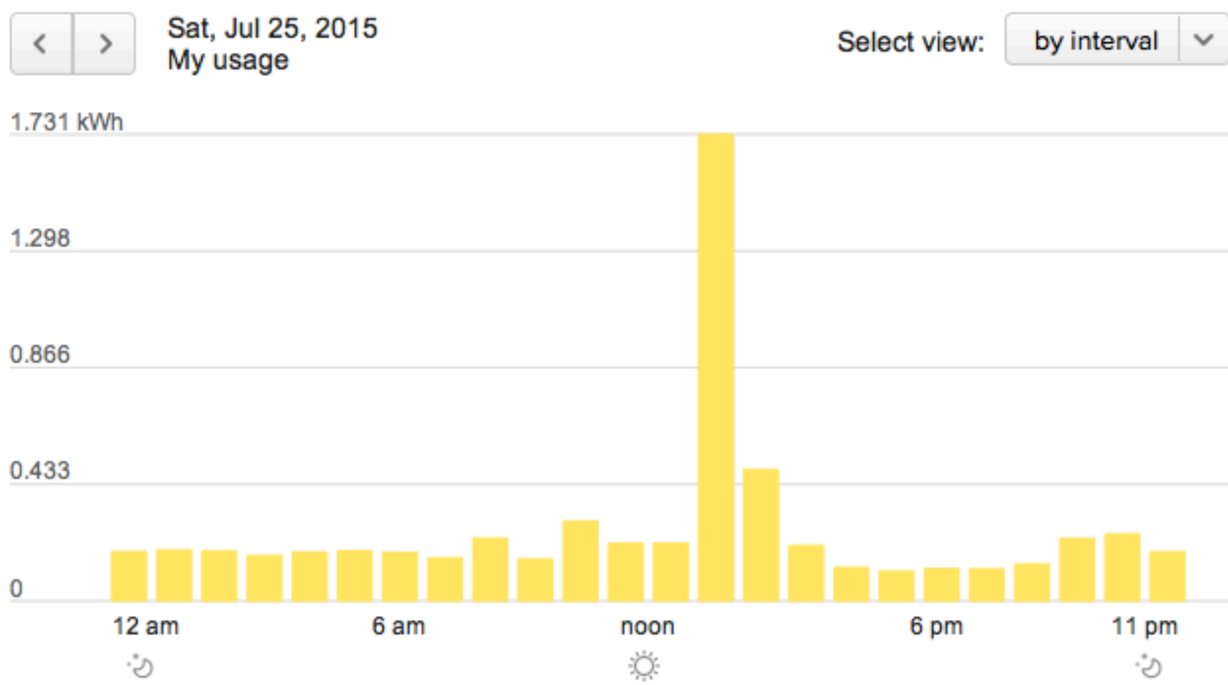
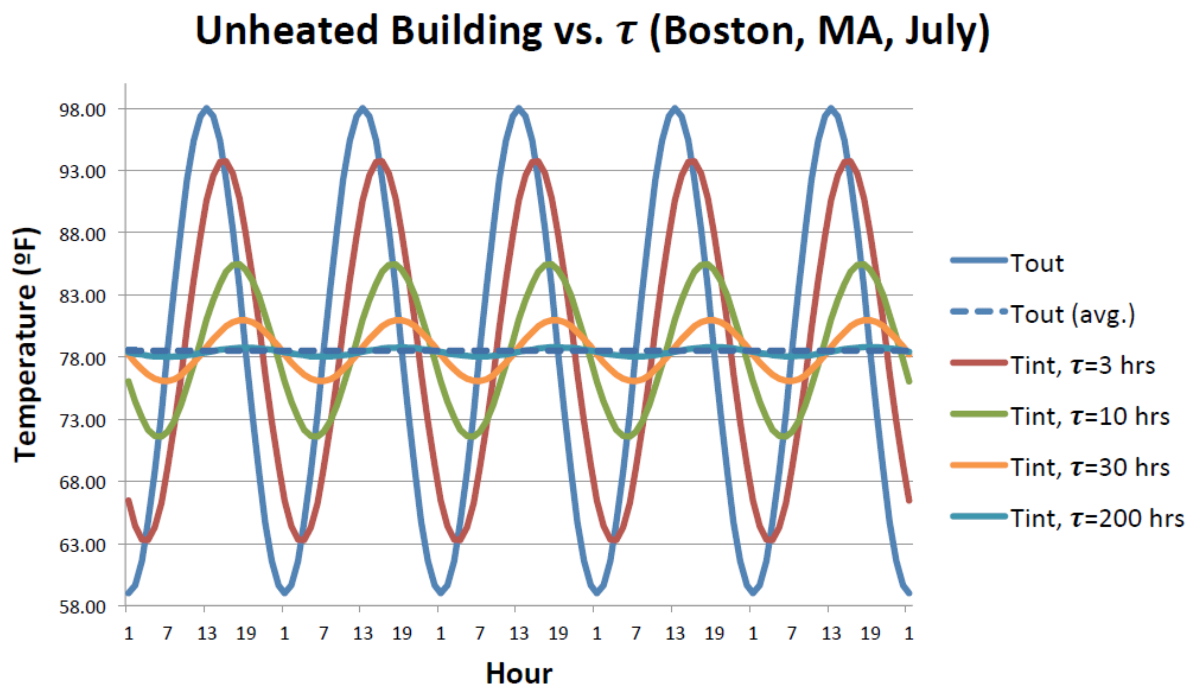


Figure 6 Building Time Constant (τ) vs. Diurnal Temperature Delta (courtesy of Graham Irwin Essential Habitat)



- **Time Constant (τ) = Thermal Mass (Wh/K)/Conductance (W/K)**
- **τ + solar & int. gains + air changes = "reaction speed" of building to ΔT.**
- **Passive House: τ = 5-30+ days (120-720+ hrs.)** - ***Heating load in Passive Houses*, Passipedia**