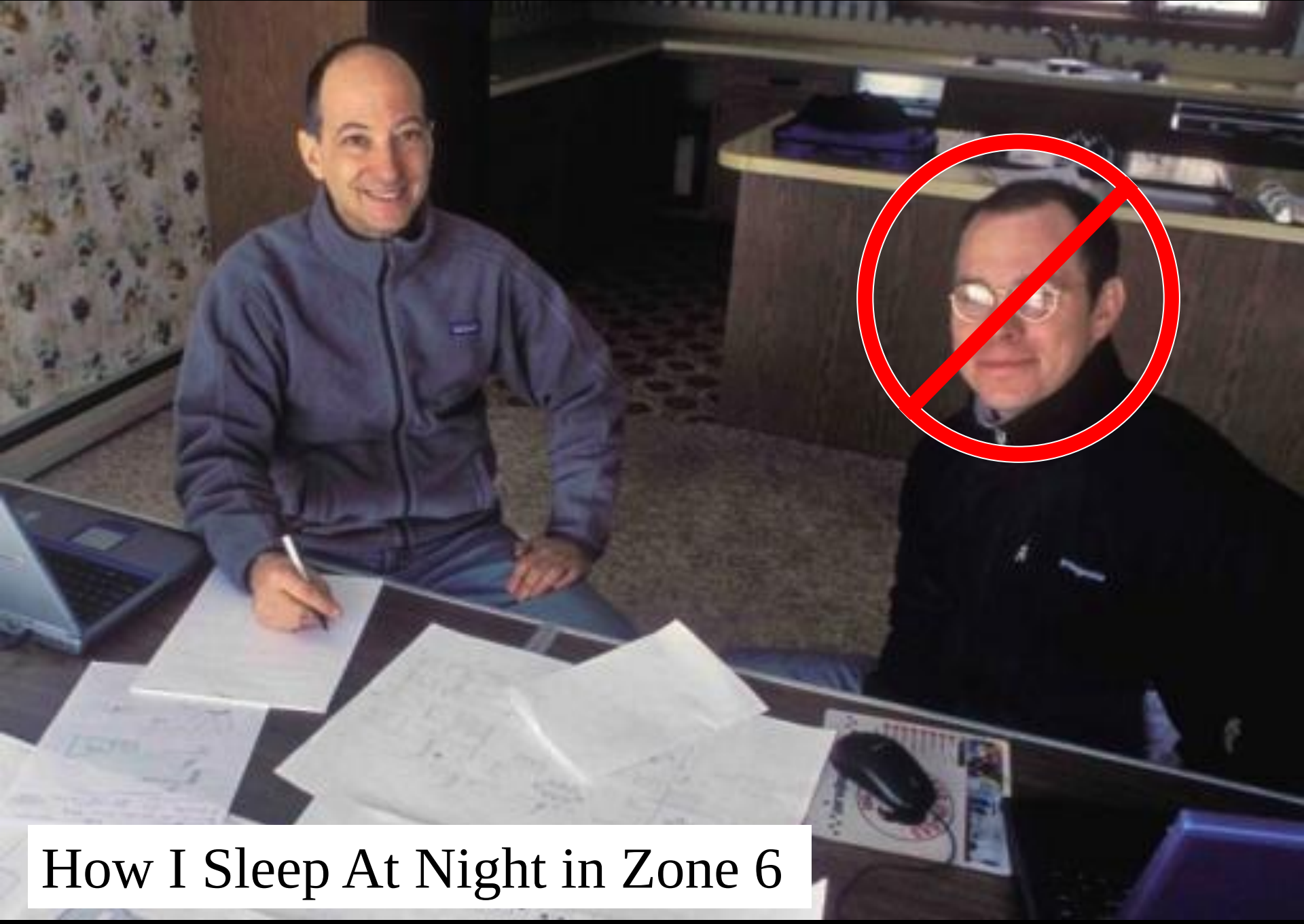
Marc’s Slides

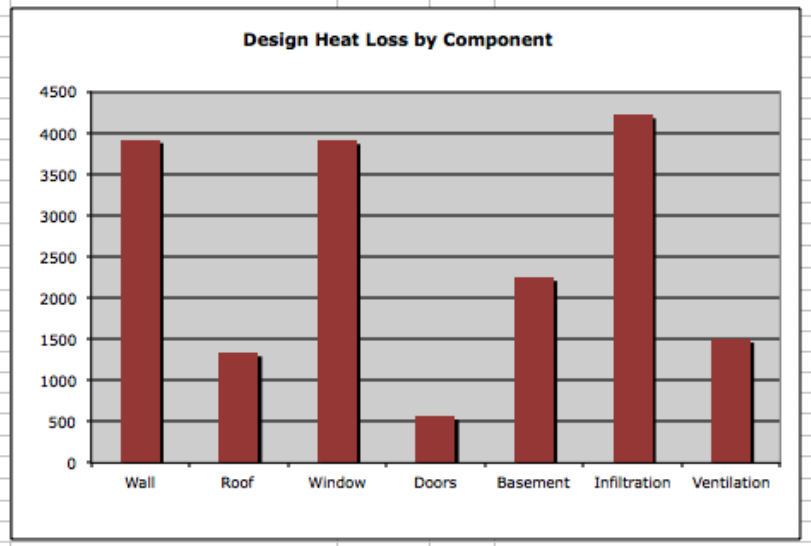


How I Sleep At Night in Zone 6

Marc Rosenbaum, PE – South Mountain Company – Martha's Vineyard, MA

Modeling Exercise

	A	B	C	D	E	F	G	H	I	J
1	**Heat Loss Calculator**	This is a simple spreadsheet calculator to estimate annual energy use for heating for a house - not a substitute for hourly simulation								
2	**User inputs go into cells with yellow fill**									
3				Design Temperature Difference	74					
4							Gross Heated Floor Area	2160		
5	R VALUES						Heating Degree Days base 70	8623		
6	Wall R Value	40.00		Flat Ceiling R Value			Frostwall (heated) R value	0.00		
7	Floor over unheated space R Value			Skylight R Value			Basement Wall R Value	30.00		
8	Window R Value	5.50		Opaque Door R Value			Underslab R Value	20.00		
9	Sloped Ceiling R Value	60.00		Glass Door R Value	5.50					
10	Floor over outdoors R Value									
11										
12	ELEMENT	AREA	AU	Heat loss BTU/hour			Component	Design Heat Loss, BTU/hour		
13	Wall	2116	52.9	3915			Wall	3915	22%	
14	Floor over outdoors	0	0.0	0			Roof	1332	8%	
15	Window	290	52.7	3902			Window	3902	22%	
16	Sloped Ceiling	1080	18.0	1332			Doors	565	3%	
17	Flat Ceiling	0	0.0	0			Basement	2244	13%	
18	Skylight	0	0.0	0			Infiltration	4214	24%	
19	Opaque Door	0	0.0	0			Ventilation	1499	8%	
20	Glass Door	42	7.6	565				17670		
21	Floor over basement	0	0.0	0						
22	Basement wall above grade		0.0	0						
23										
24		PERIMETER								
25	Slab on grade (heated space)	0	0.0	0						
26	Basement Wall (heated space)	120	30.3	2244						
27	Basement fraction of temperature difference	0.90								
28	INFILTRATION Volume	ACH	Equiv. AU	CFM average air leakage						
29	23787	0.03	13.2	4214	12					
30	Ventilation	CFM								
31		75	20.3	1499						
32										
33	AU Conduction to outdoors only	159		CFM50/shell sf	0.050					
34	AU Conduction to basement only	0		Shell ft2	5273					
35	AU Total to outdoors	236		Blower door CFM50	264					
36	Design Heat Loss, BTU/Hr	17446		Electric use, kWh/month						
37	Design Heat Loss, kW	5.1		Electric use, kWh/year	4800					
38	Design Heat Loss/ft2, BTU/Hr/ft2	8.1		DHW use, BTU/year	5.1E+06					
39				DHW use. kWh/year	1495					
40	Gross annual heat load, BTU/year	3.77E+07		DHW use, galsLPG/year	56					
41	Net annual heat load, BTU/year	1.26E+07								
42	Net annual heat load, kWh	3696		Total net thermal use, BTU/year	1.8E+07					
43	Additional heating load from HPWH	882		Total electric usage heat pump plus household	8,126					
44	COP of heat pump	2.5		kW PV required for ZNEH	6.5					
45	Net annual heat load, kWh, w/heat pump	1478								
46	Net annual heat/HPWH load, kWh, w/heat pump	353								
47		1831								
48										



Assumptions

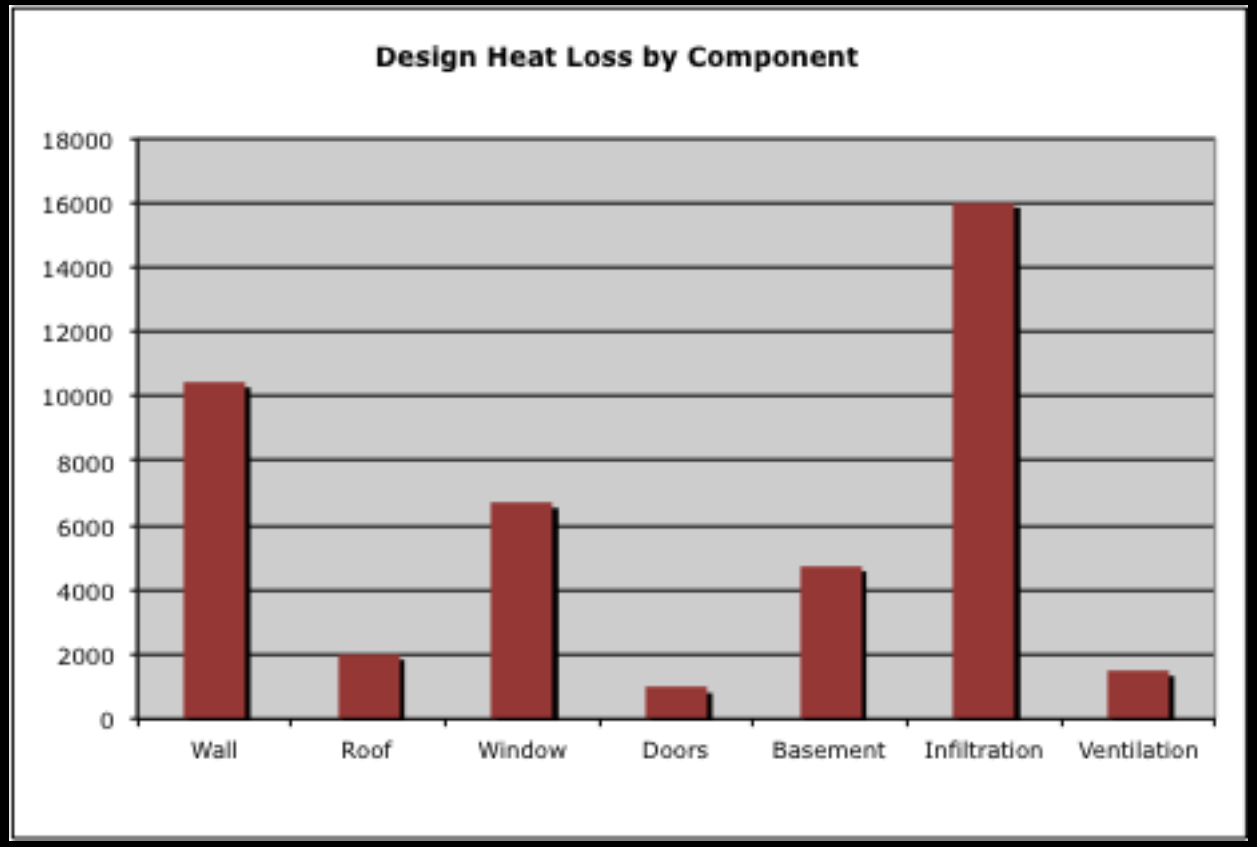
- Concord, NH weather and insolation
- 24’x36’ 2-1/2 story house, full basement, unshaded facing south, some shading on east and west
- Windows/doors - 221 ft2 S; 51 ft2 N; 30 ft2 E and W
- Windows/doors 70% glazed area; SHGC 0.585
- No cooling loads modeled
- Ventilation 75 CFM at 75% effectiveness
- DHW with HPWH COP 2.5; 45 gpd; 2 kWh/day standby loss
- DHW energy taken from the house added to DHW load
- House heated with heat pump COP 2.5
- Plug/light/ appliances 400 kWh/month, 50% offsets heat load

11 Cases

	Wall R	Basement R	Roof R	Window/Door R	CFM50/ft2
Code	15	10	40	3.2	0.19
1	15	10	40	5.5	0.05
2	30	20	40	5.5	0.05
3	40	20	40	5.5	0.05
4	40	30	40	5.5	0.05
5	40	30	60	5.5	0.05
6	40	30	60	7.0	0.05
7	40	30	60	5.5	0.025
8	40	30	60	7.0	0.025
9	60	30	60	7.0	0.025
10	60	30	90	7.0	0.025

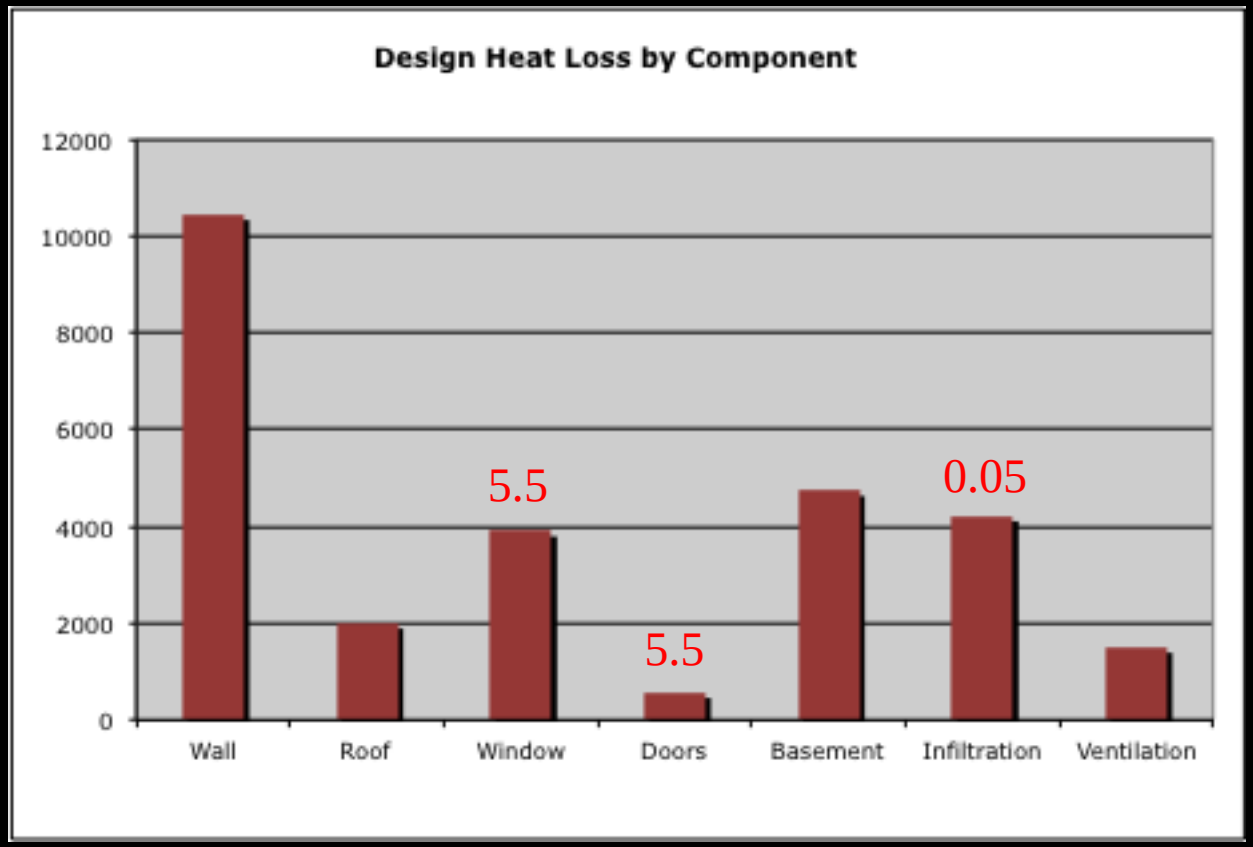
Code

Design Heat Loss, BTU/hour	42,364
Annual Heating Consumption, kWh	5,731
Annual Total Energy, kWh	12,378



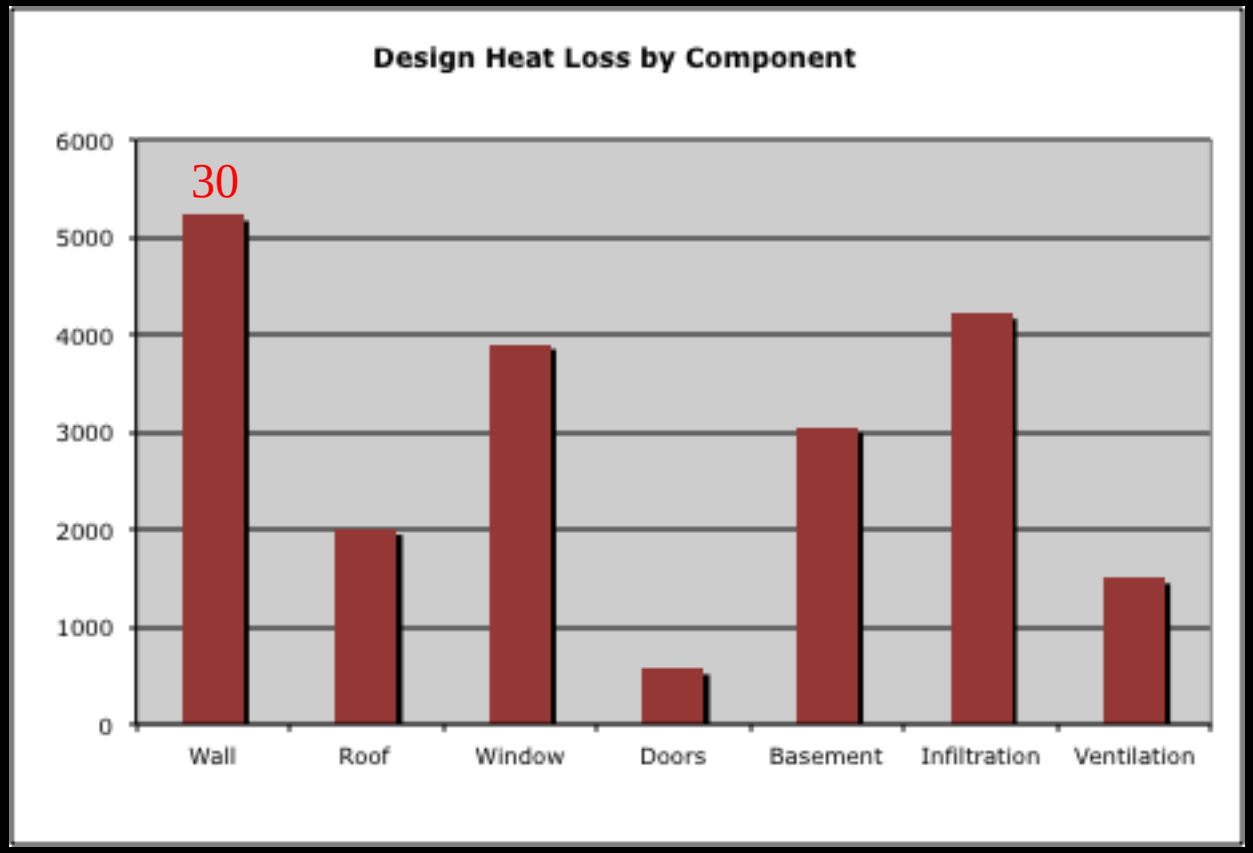
Case 1

Design Heat Loss, BTU/hour	27,354
Annual Heating Consumption, kWh	4,002
Annual Total Energy, kWh	10,650

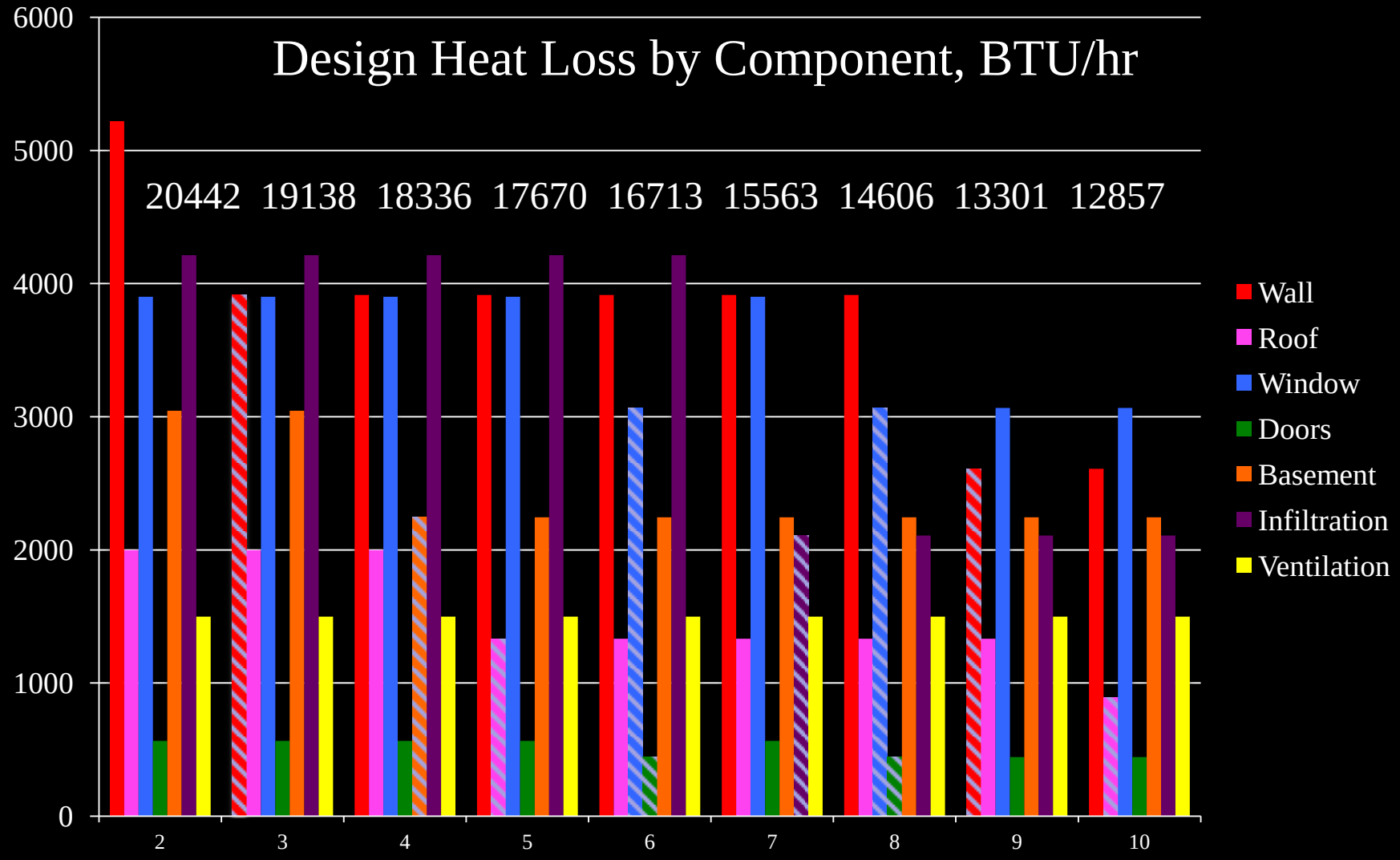


Case 2

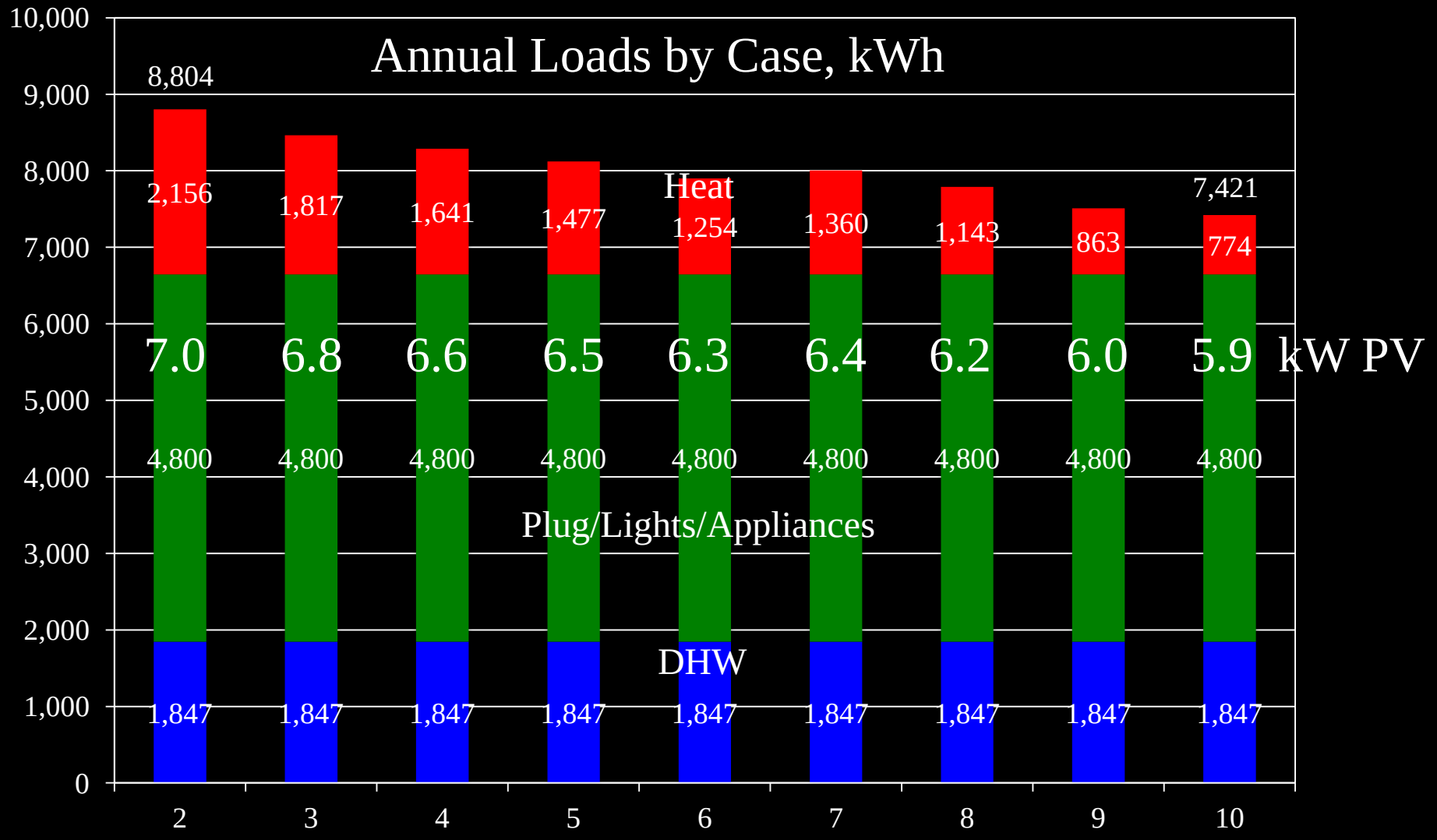
Design Heat Loss, BTU/hour	20,442
Annual Heating Consumption, kWh	2,156
Annual Total Energy, kWh	8,804



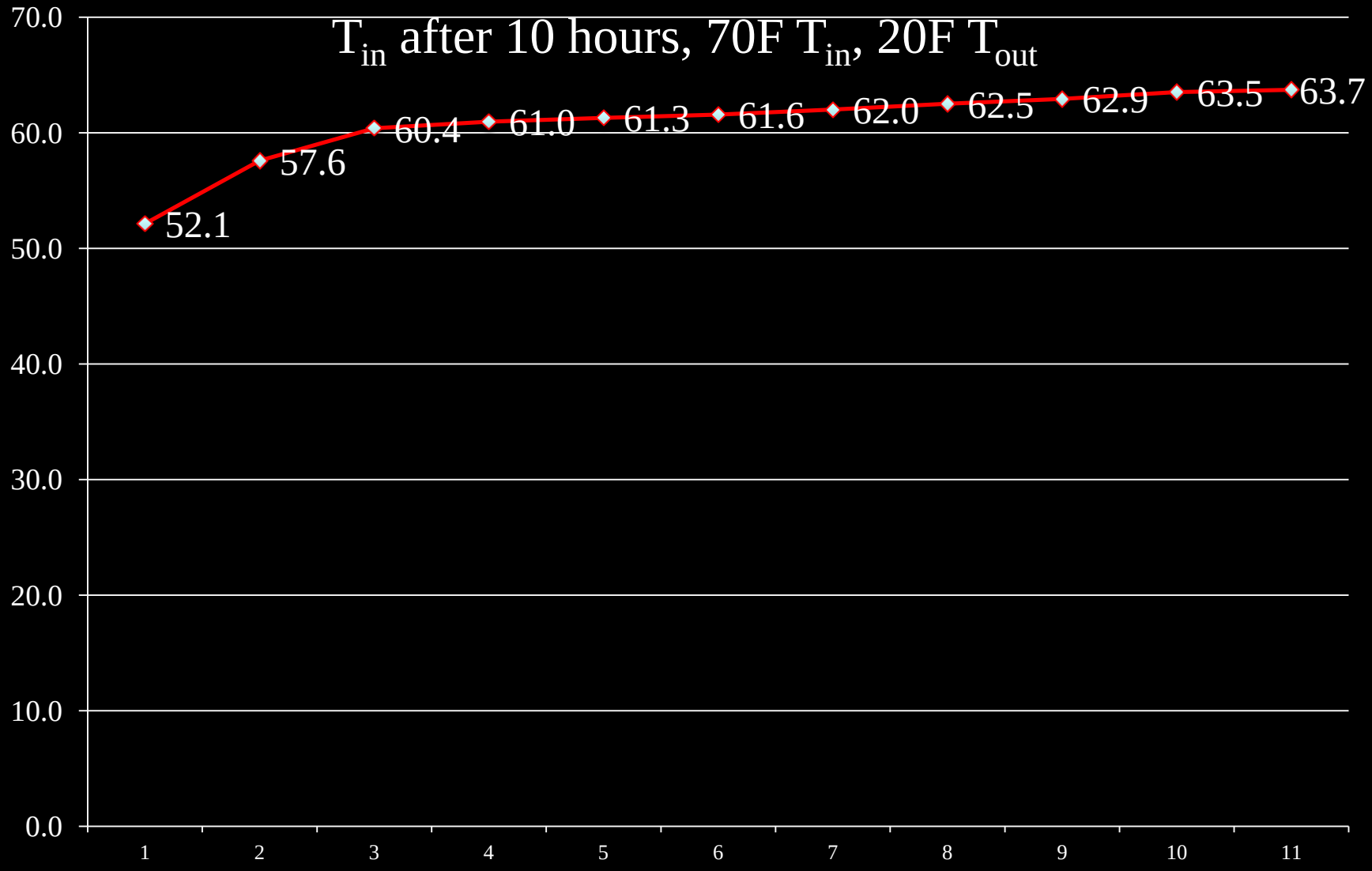
Cases – Design Heat Loss



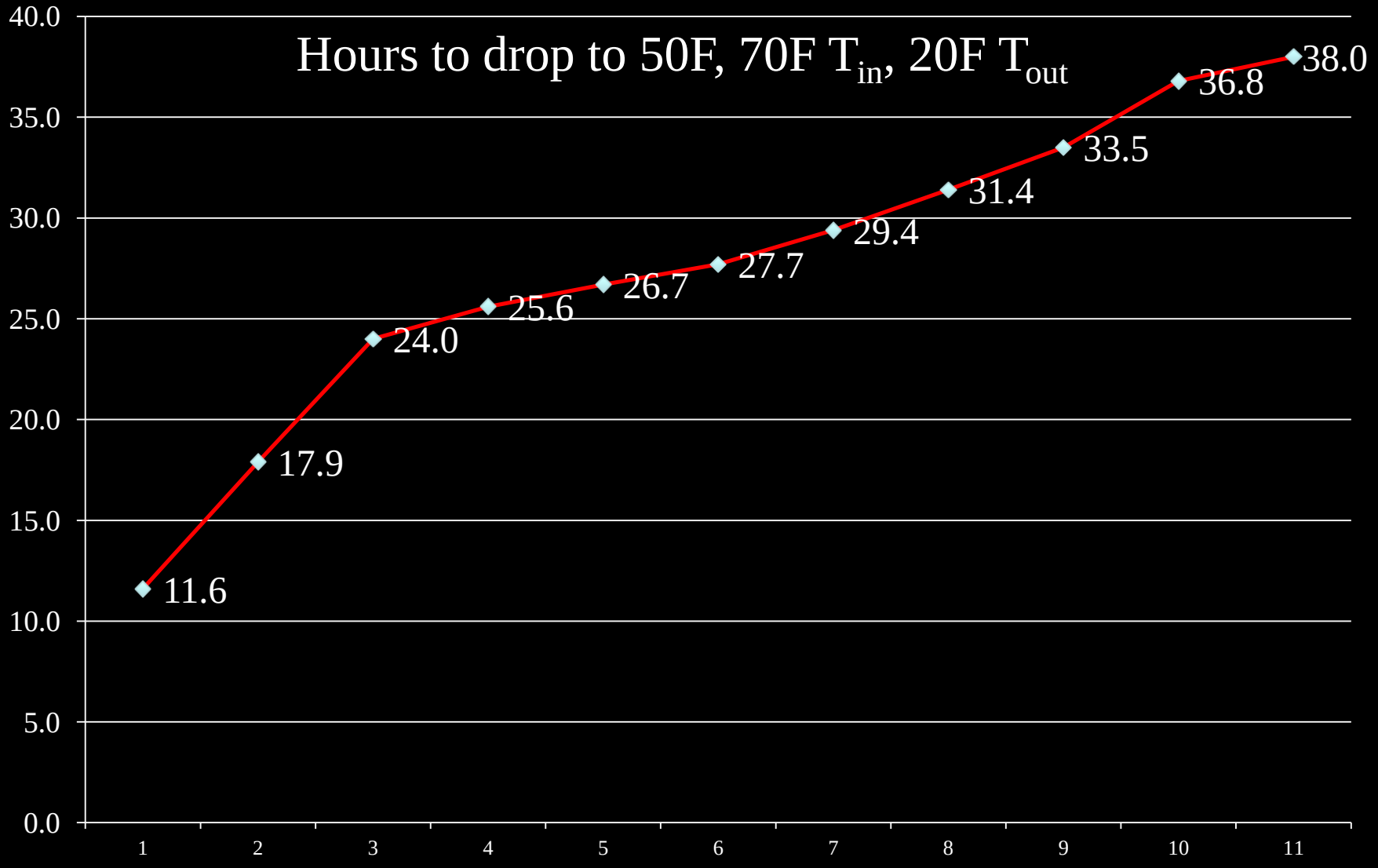
Cases – Annual Heating/Total Energy



Time Constant -10 Hour coast down



Time Constant – coast down to 50F



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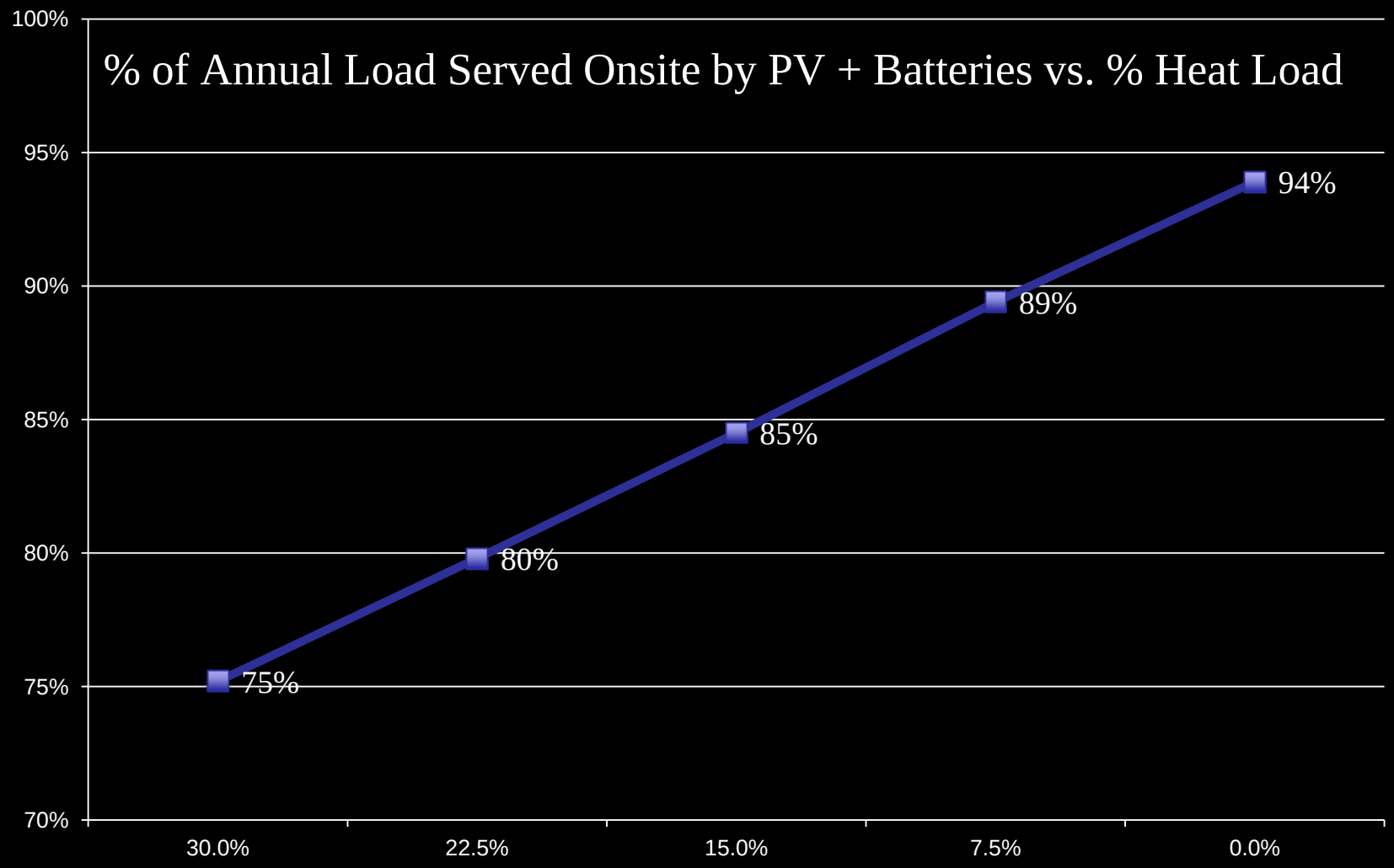
Zero Energy…


% of Annual Load Served Onsite by PV + Batteries vs. % Heat Load
100%
95%
90%
85%
80%
75%
70%
94%
89%
85%
80%
75%
30.0%
22.5%
15.0%
7.5%
0.0%

Thank You

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