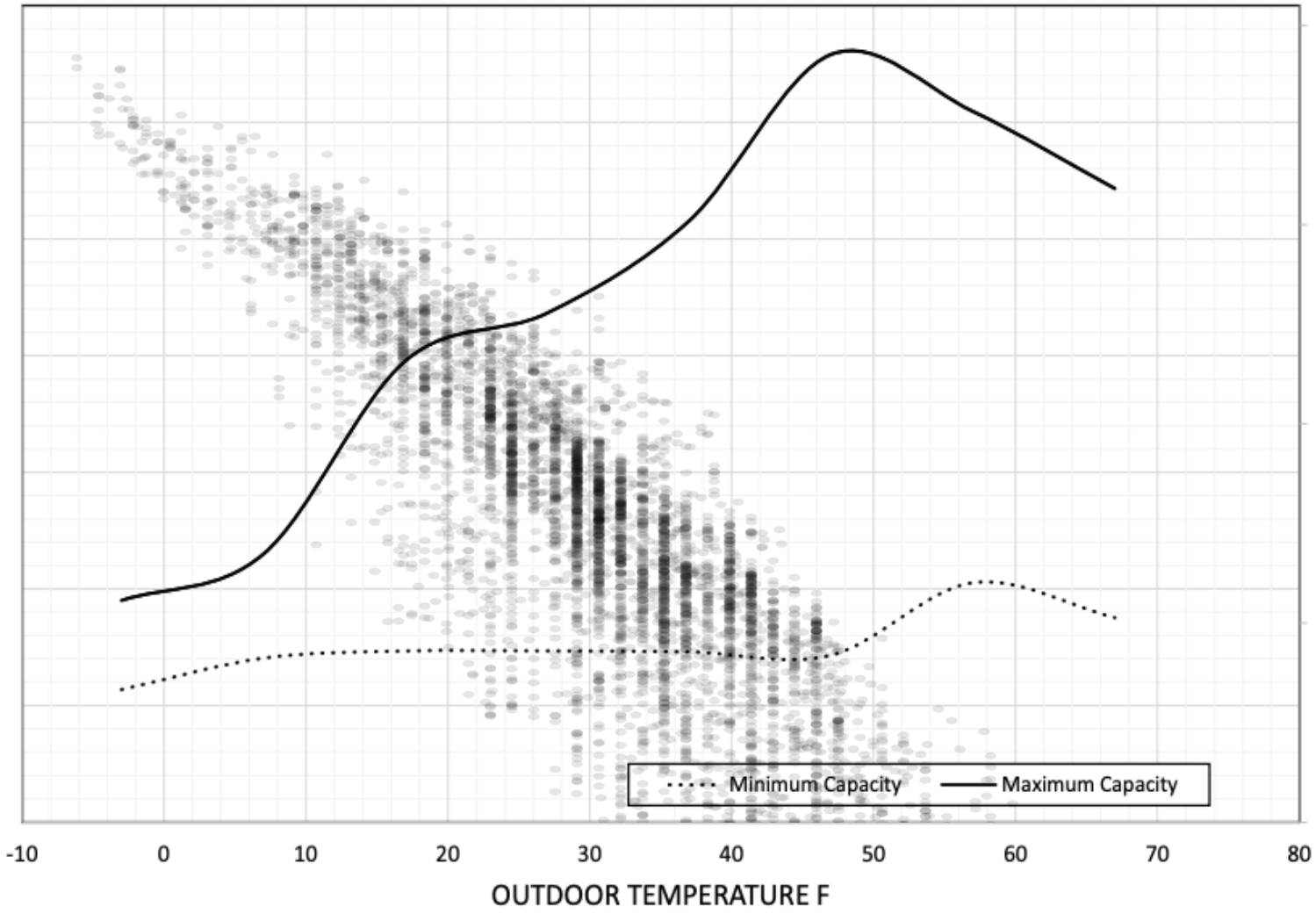
Demystifying Heat Pump Performance Data



Neal Kruis, PhD, Big Ladder Software

Heat-pump sales in U.S. need to soar

Growth in electric heat-pump sales would have to follow an S-curve to meet climate goals

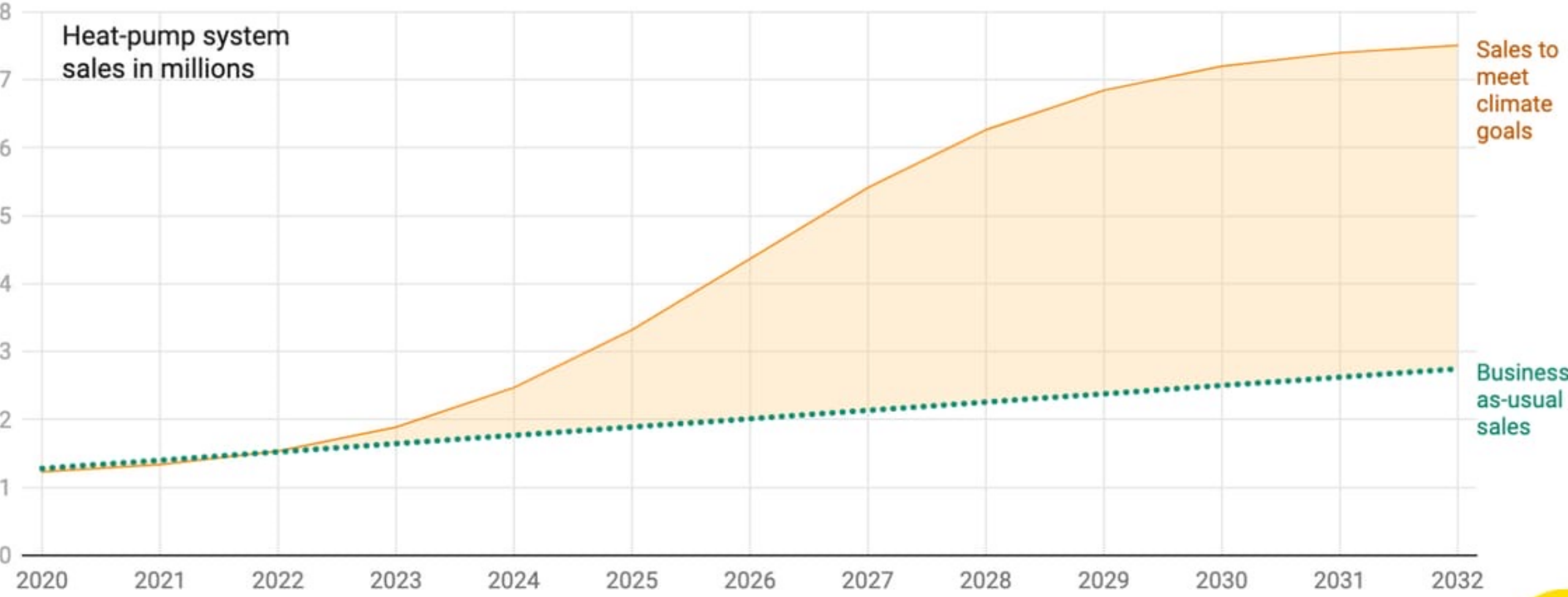
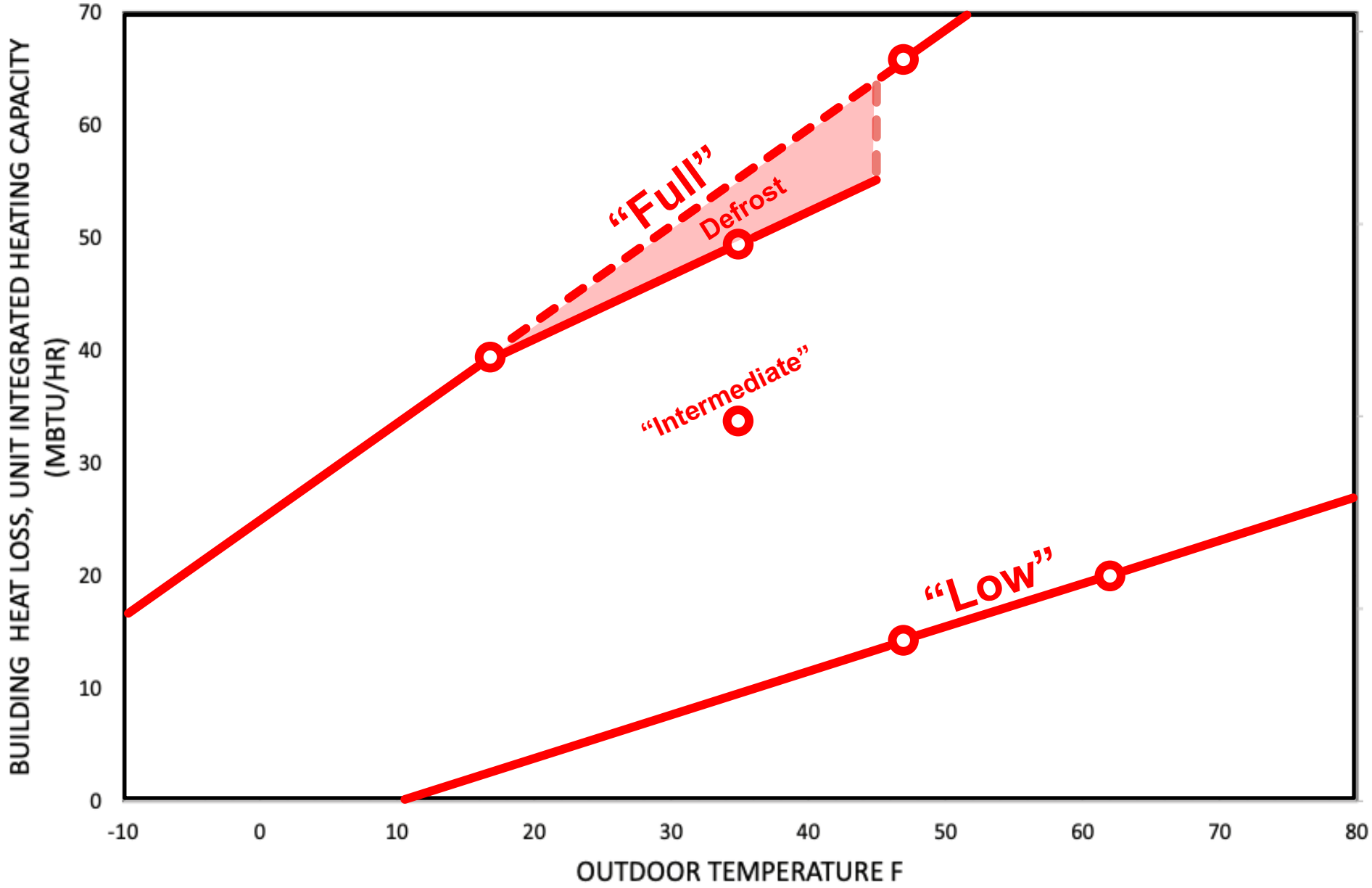
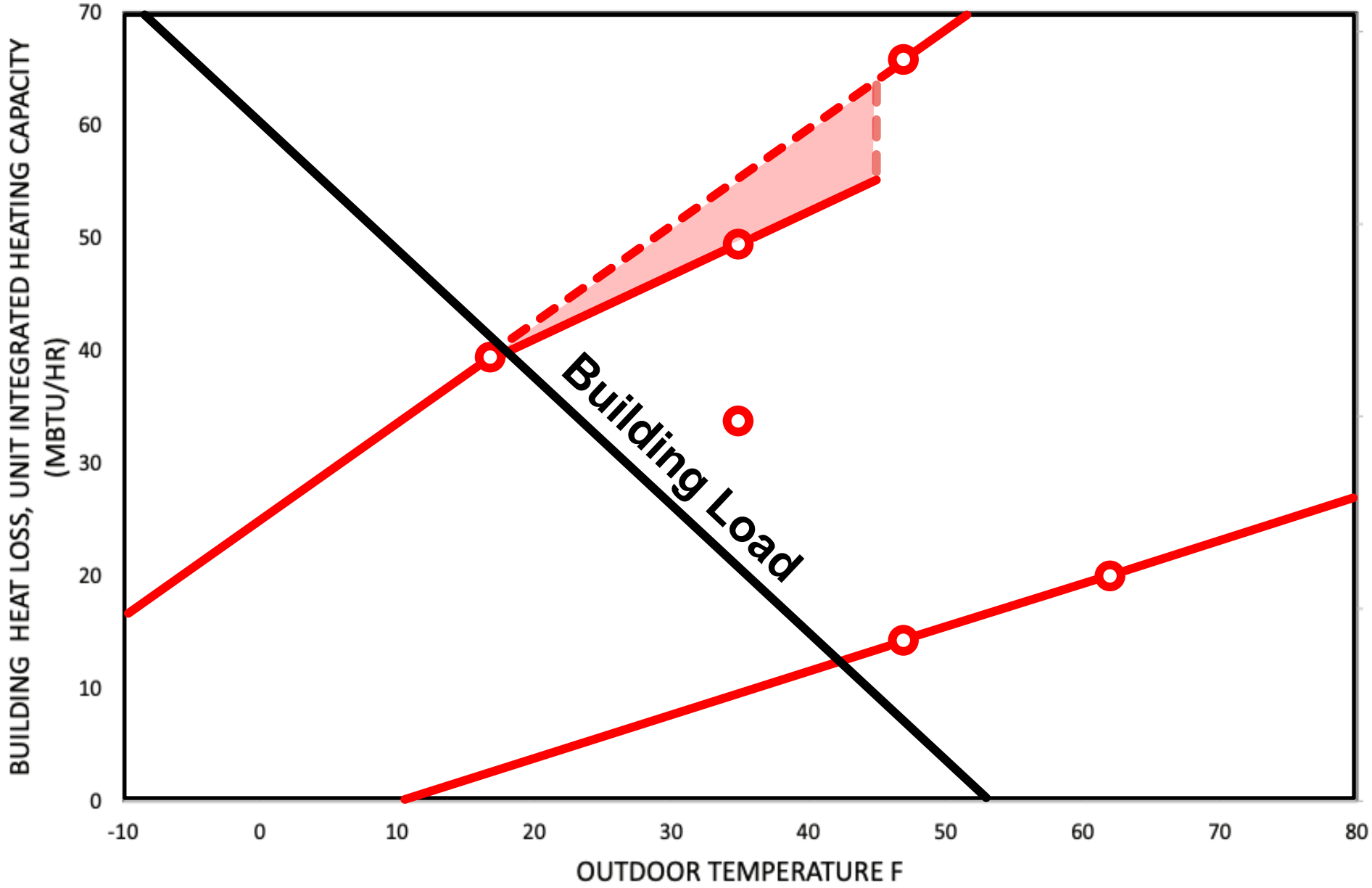
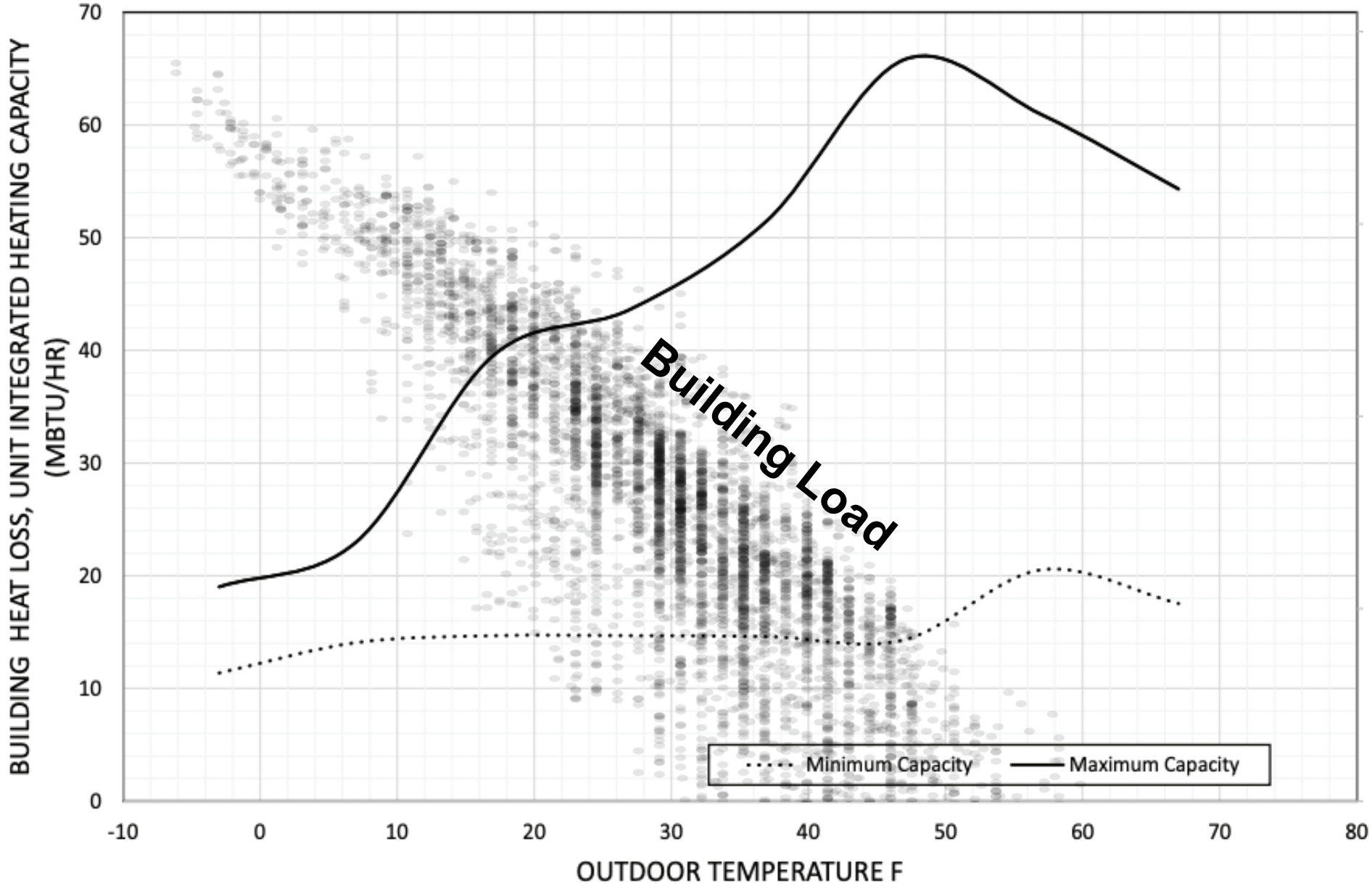


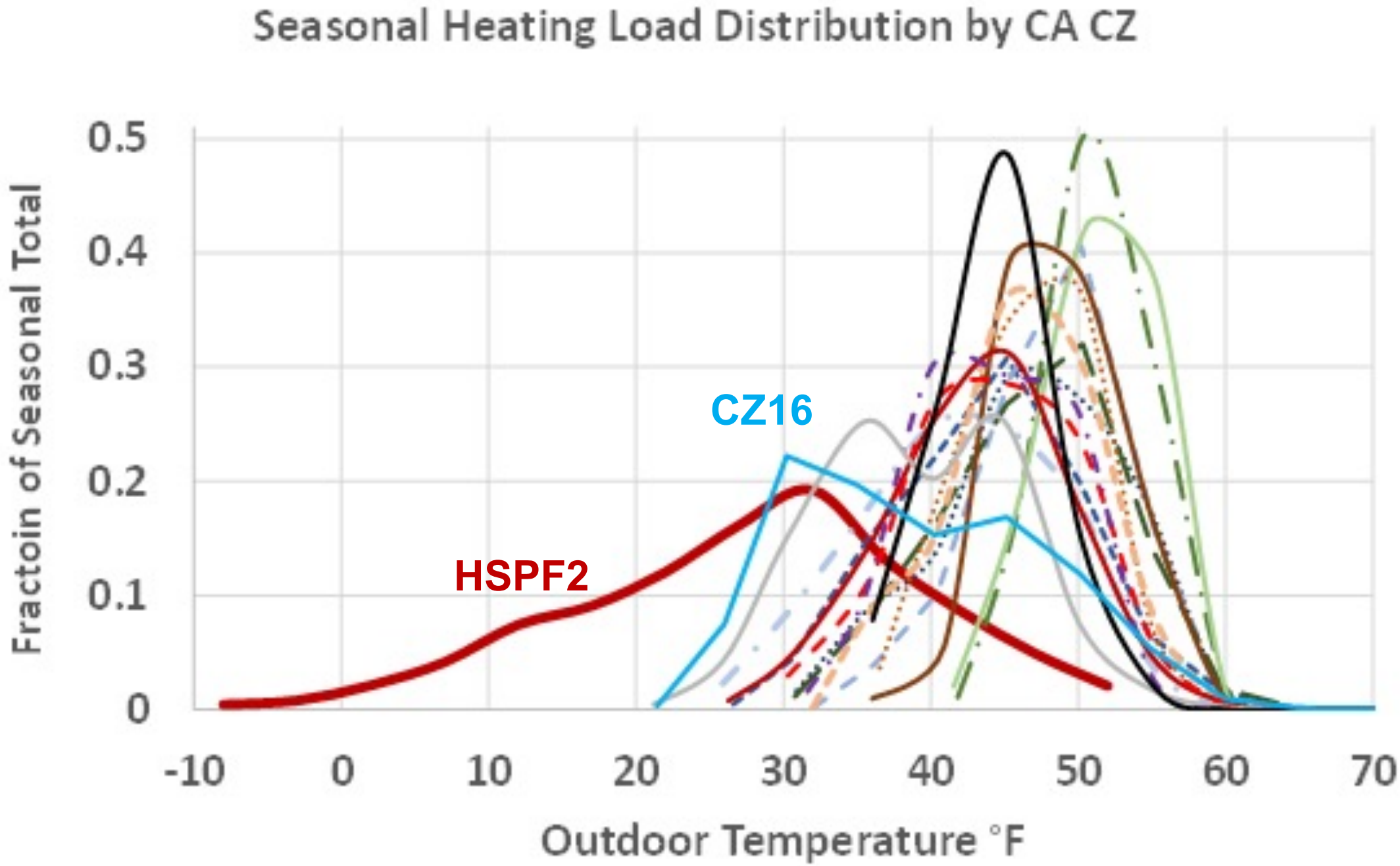
Chart: Canary Media Source: Rewiring America, Pace of Progress 2023


BUILDING HEAT LOSS, UNIT INTEGRATED HEATING CAPACITY (MBTU/HR)
70
60
50
40
30
20
10
0
-10
0
10
20
30
40
50
60
70
80
OUTDOOR TEMPERATURE F
"Full"
Defrost
"Intermediate"
"Low"

HSPF2?


BUILDING HEAT LOSS, UNIT INTEGRATED HEATING CAPACITY
(MBTU/HR)
70
60
50
40
30
20
10
0
-10
0
10
20
30
40
50
60
70
80
OUTDOOR TEMPERATURE F
Building Load


BUILDING HEAT LOSS, UNIT INTEGRATED HEATING CAPACITY (MBTU/HR)
70
60
50
40
30
20
10
0
-10
0
10
20
30
40
50
60
70
80
OUTDOOR TEMPERATURE F
Building Load
Minimum Capacity
Maximum Capacity


Seasonal Heating Load Distribution by CA CZ
Fractoin of Seasonal Total
0.5
0.4
0.3
0.2
0.1
0
-10
0
10
20
30
40
50
60
70
Outdoor Temperature °F
CZ16
HSPF2

Seasonal ratings are just **oversimplified energy models** of the **wrong home** in the **wrong climate**

NEEP'S COLD CLIMATE AIR SOURCE

Heat Pump List

Product Type | Ducting Configuration | Brand | AHRI, Model, Unit | Heating Capacity 47°F Rated Btu/h | Heating Capacity 5°F Max Btu/h

All Product Typ | All Ducting Cor | All Brands | AHRI, Model or Ur | 0 — 80000 | 0 — 80000

ENERGY STAR Certified

- ☐ ENERGY STAR V6.1
- ☐ ENERGY STAR V6.1 Cold Climate

Eligible for Federal Tax Credit

- ☐ North
- ☐ South

Advanced Search - Sizing for Heating

Design Load Calculators

‹ 1 2 3 4 5 6 7 8 9 10 › (144921 Heat Pumps)

Grid View | List View

DAIKIN Daikin Fit

Central Air Conditioning Heat Pump (HP)
Singlezone Ducted, Centrally Ducted
AHRI Cert #: **212614942**
Outdoor Unit Model #: **DZ6VSA481EA***
Indoor Model #: **CA*EA6030*4A***
Maximum Heating Capacity (Btu/h) @5°F: **31,000**
Rated Heating Capacity (Btu/h) @47°F: **44,000**
Rated Cooling Capacity (Btu/h) @95°F: **44,000**

Basic View

Advanced Data - Sizing for Heating

Information Tables

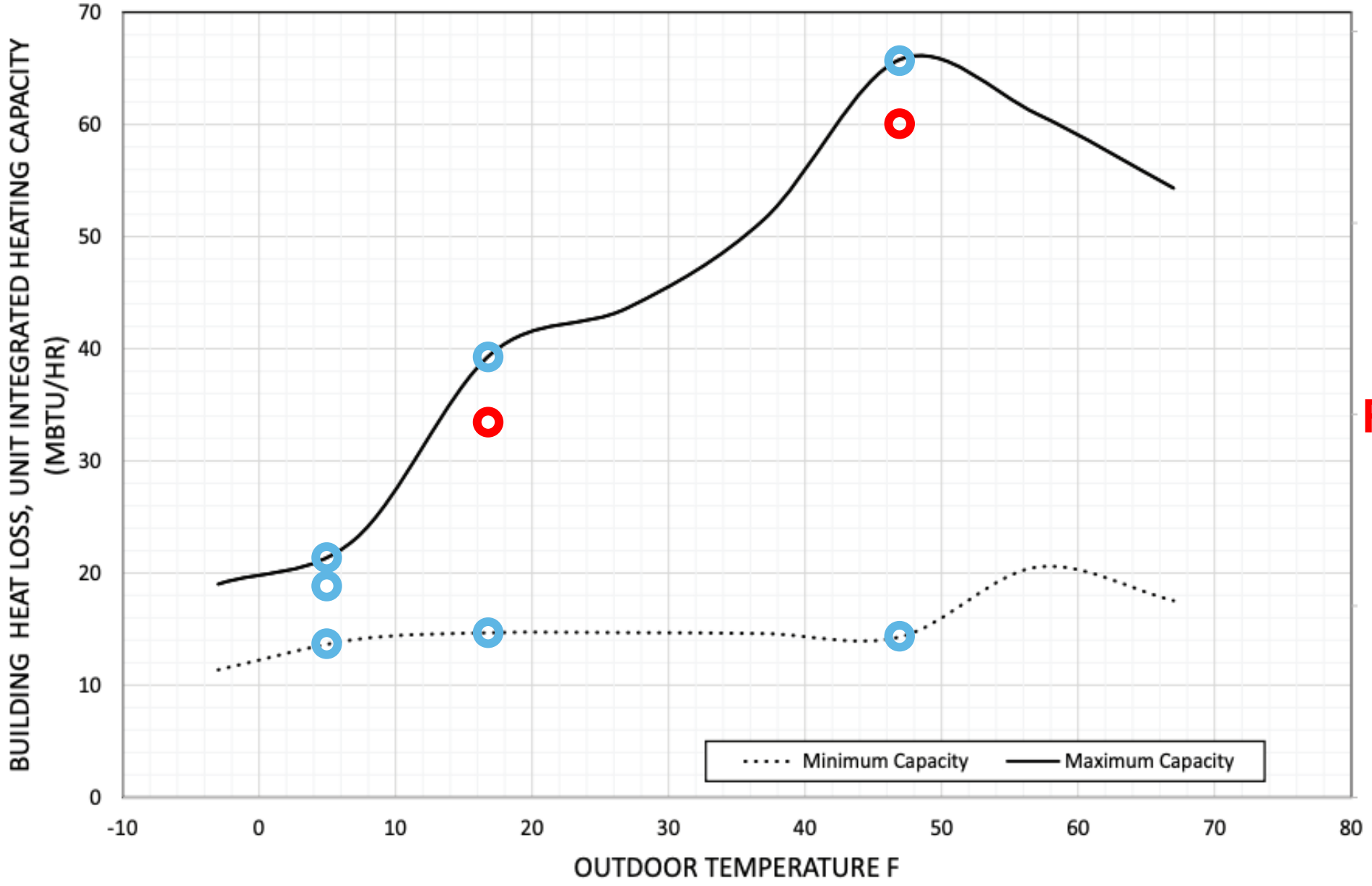
Brand	DAIKIN
Series	Daikin Fit
Ducting Configuration	Singlezone Ducted, Centrally Ducted
AHRI Certificate #	212614942
Outdoor Unit Model #	DZ6VSA481EA*
Indoor Model #	CA*EA6030*4A*
Indoor Unit Type	Ducted Indoor Units
Furnace Model #	D*96VC1005DNA*
EER	
SEER	
HSPF (Region IV)	
EER2	10
SEER2	17
HSPF2 (Region IV)	8.5
HSPF2 (Region V)	7
ENERGY STAR V6.1	✓
ENERGY STAR V6.1 Cold Climate	✓

Performance Specs

Heating / Cooling	Outdoor Dry Bulb	Indoor Dry Bulb	Unit	Min	Rated	Max
Cooling	95°F	80°F	Btu/h	14,600	44,000	44,000
			kW	1.23	4.34	4.34
			COP	3.48	2.97	2.97
Cooling	82°F	80°F	Btu/h	15,100	-	47,000
			kW	0.73	-	3.85
			COP	6.06	-	3.58
Heating	47°F	70°F	Btu/h	12,200	44,000	44,000
			kW	0.75	3.57	3.57
			COP	4.77	3.61	3.61
Heating	17°F	70°F	Btu/h	16,500	28,000	38,500
			kW	1.67	3.07	5.66
			COP	2.9	2.67	1.99
Heating	5°F	70°F	Btu/h	13,200	31,000	31,000
			kW	1.58	4.1	4.1
			COP	2.45	2.22	2.22

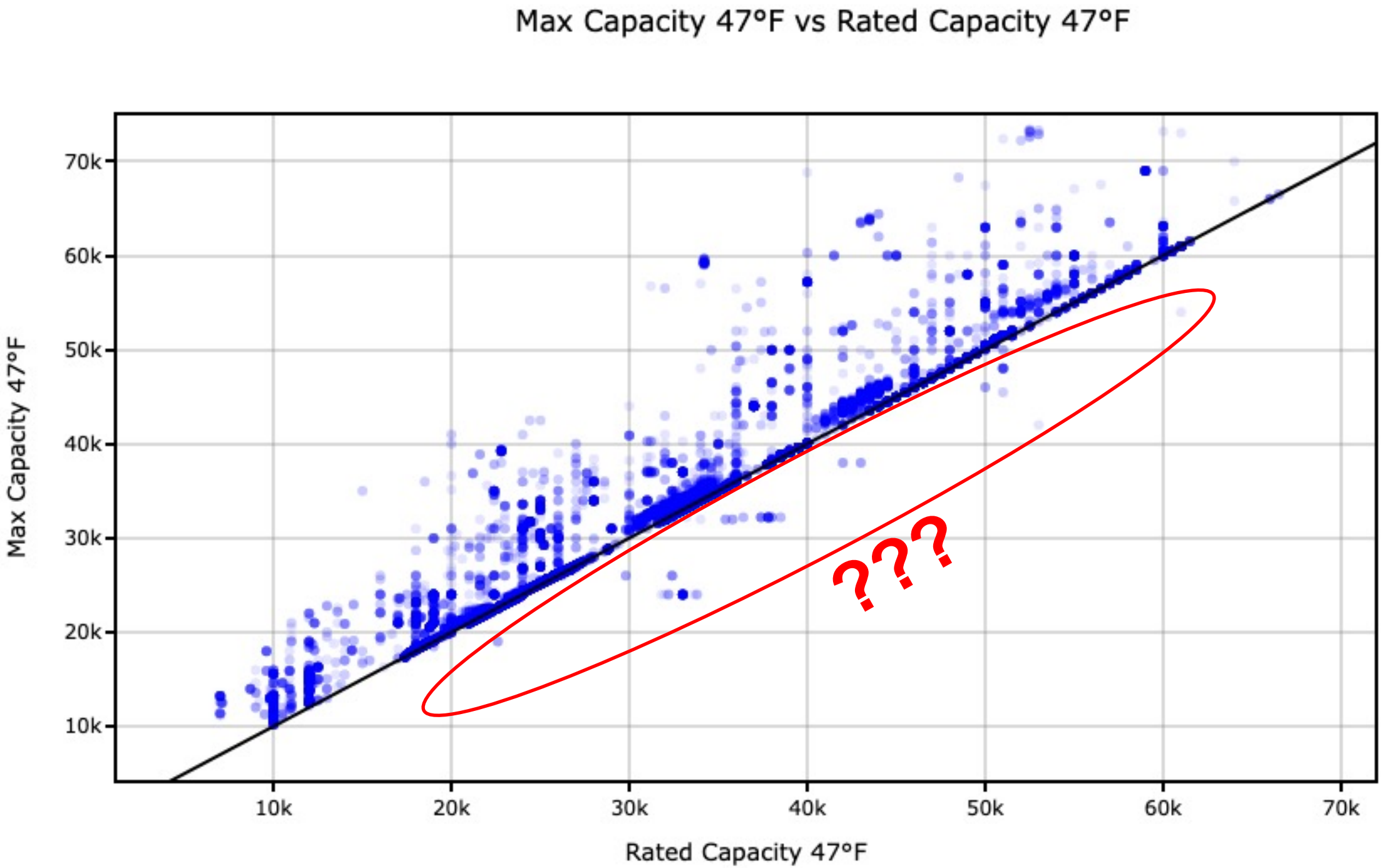
AHRI Rating Data

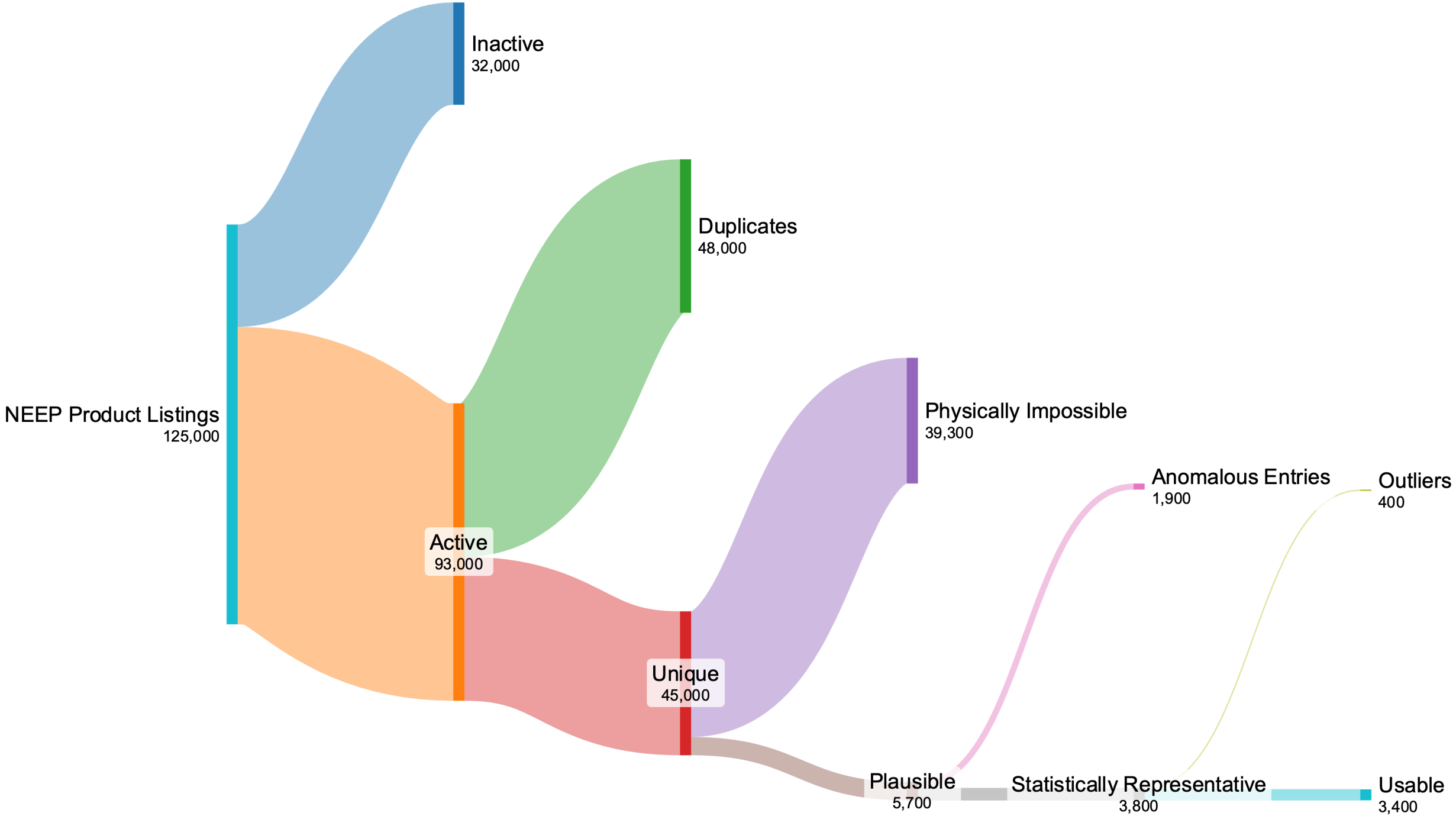
NEEP Data

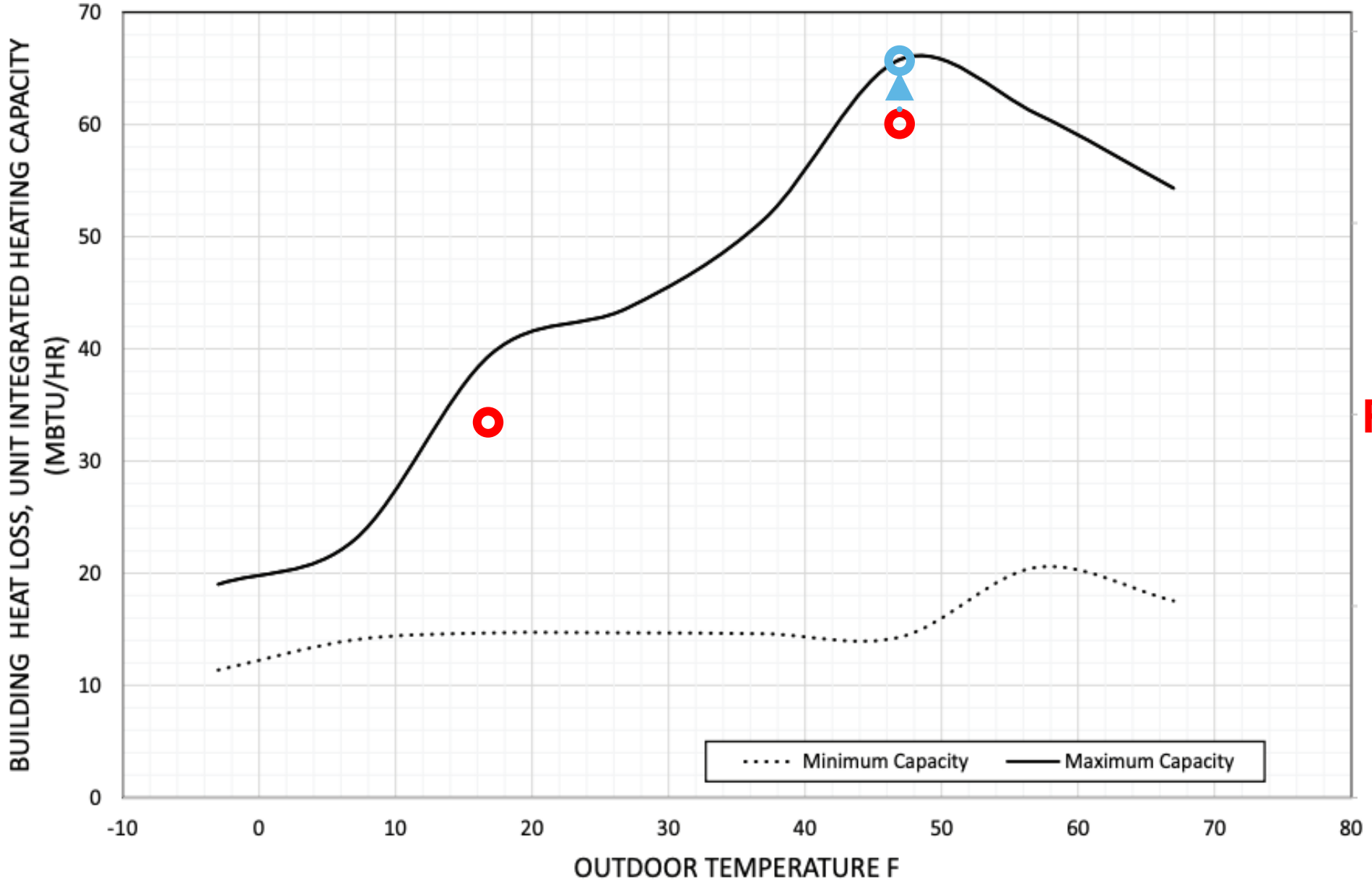


AHRI Rating Data

NEEP Data

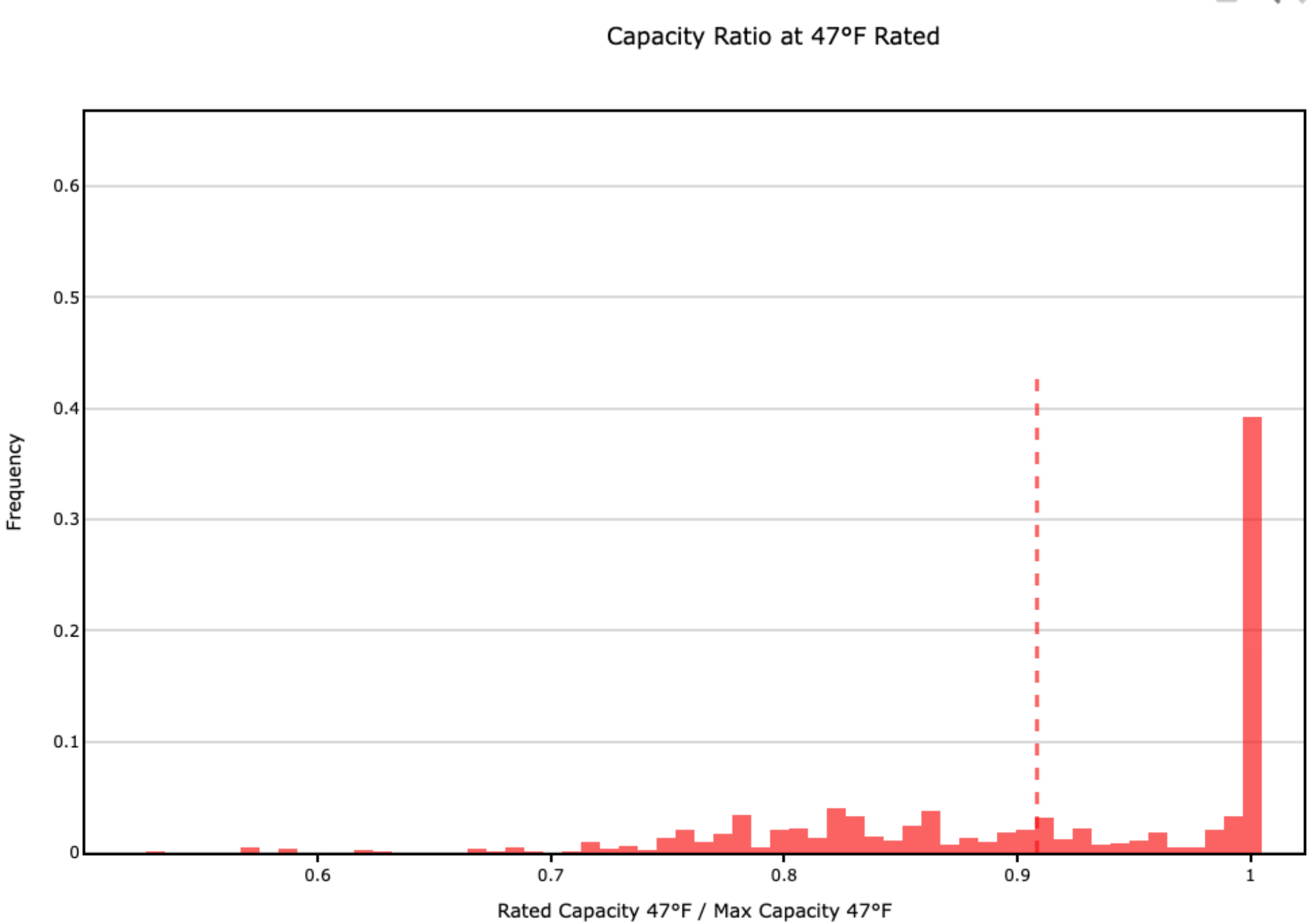

Max Capacity 47°F vs Rated Capacity 47°F
Max Capacity 47°F
70k
60k
50k
40k
30k
20k
10k
10k
20k
30k
40k
50k
60k
70k
Rated Capacity 47°F
???

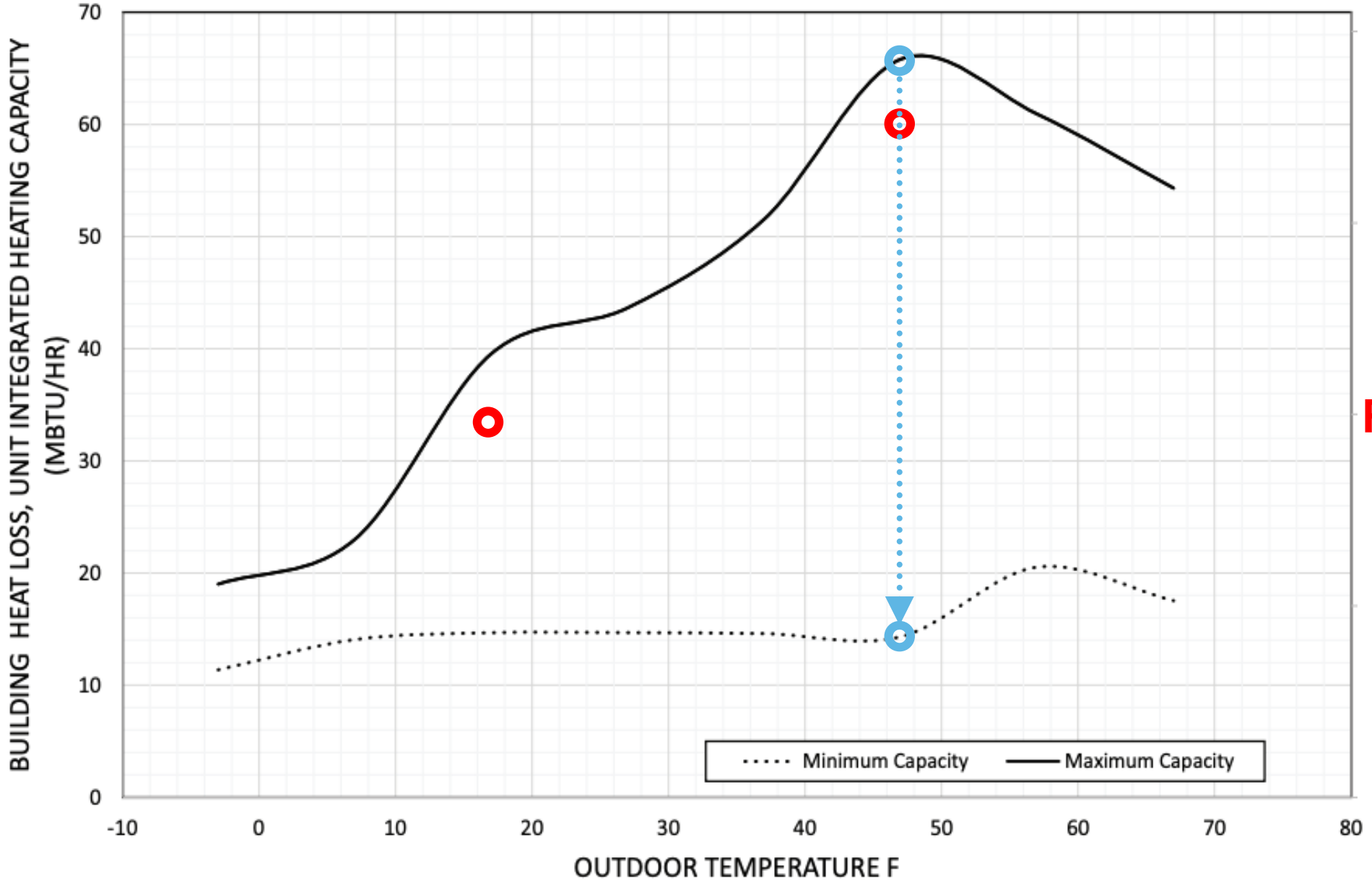

NEEP Product Listings
125,000
Inactive
32,000
Duplicates
48,000
Active
93,000
Physically Impossible
39,300
Unique
45,000
Anomalous Entries
1,900
Outliers
400
Plausible
5,700
Statistically Representative
3,800
Usable
3,400



AHRI Rating Data

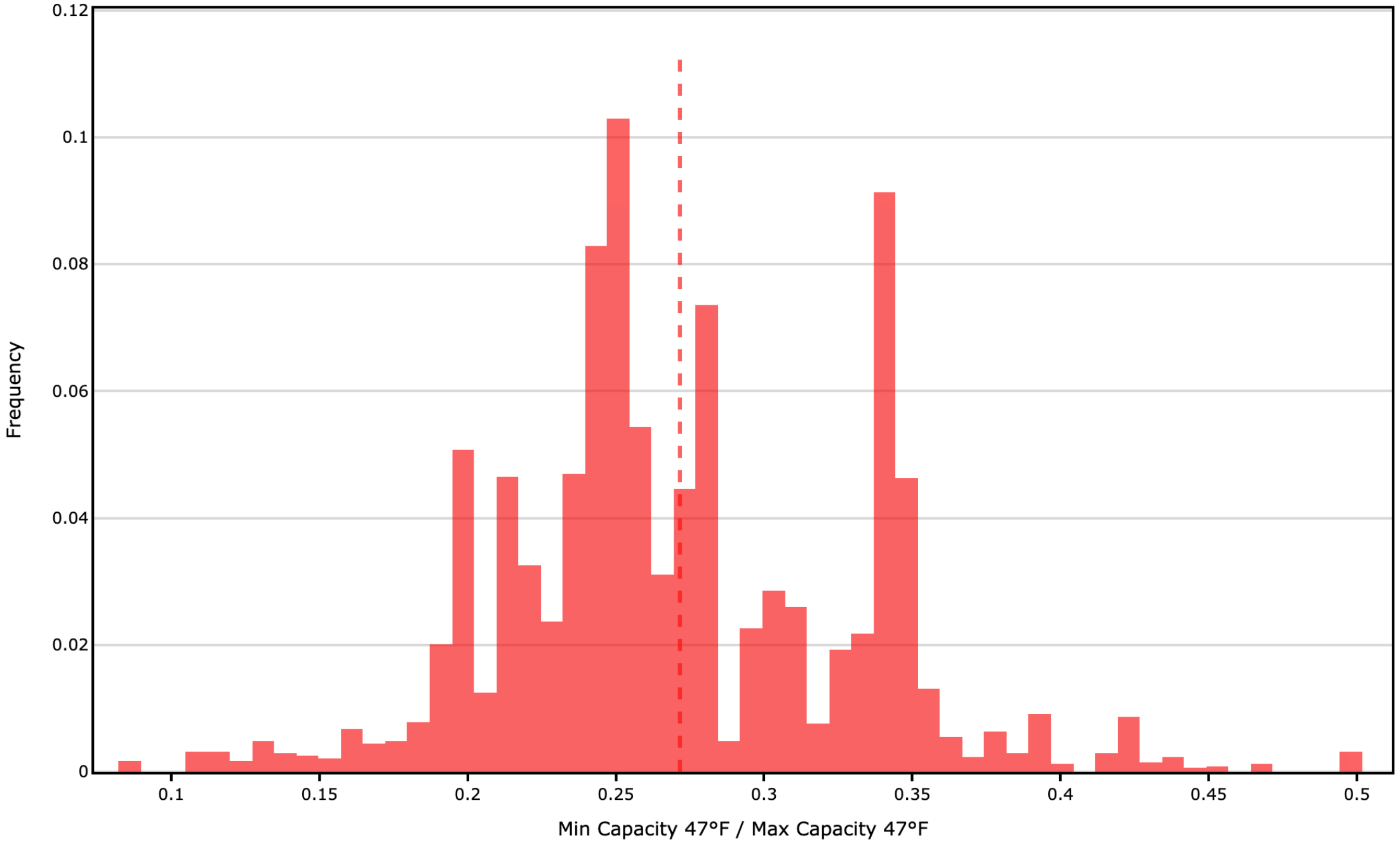
NEEP Data

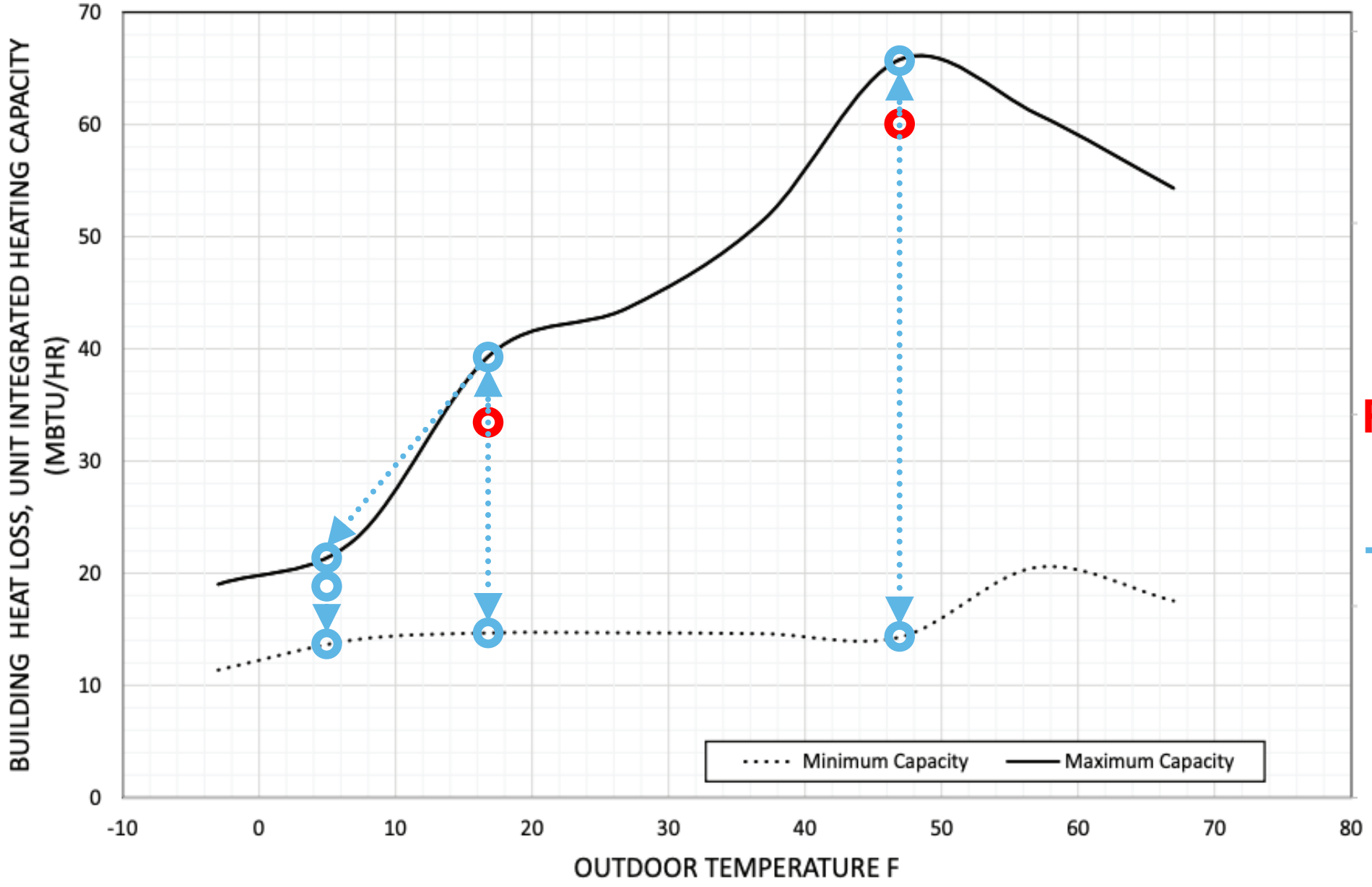

Capacity Ratio at 47°F Rated
Frequency
0.6
0.5
0.4
0.3
0.2
0.1
0
0.6
0.7
0.8
0.9
1
Rated Capacity 47°F / Max Capacity 47°F



AHRI Rating Data

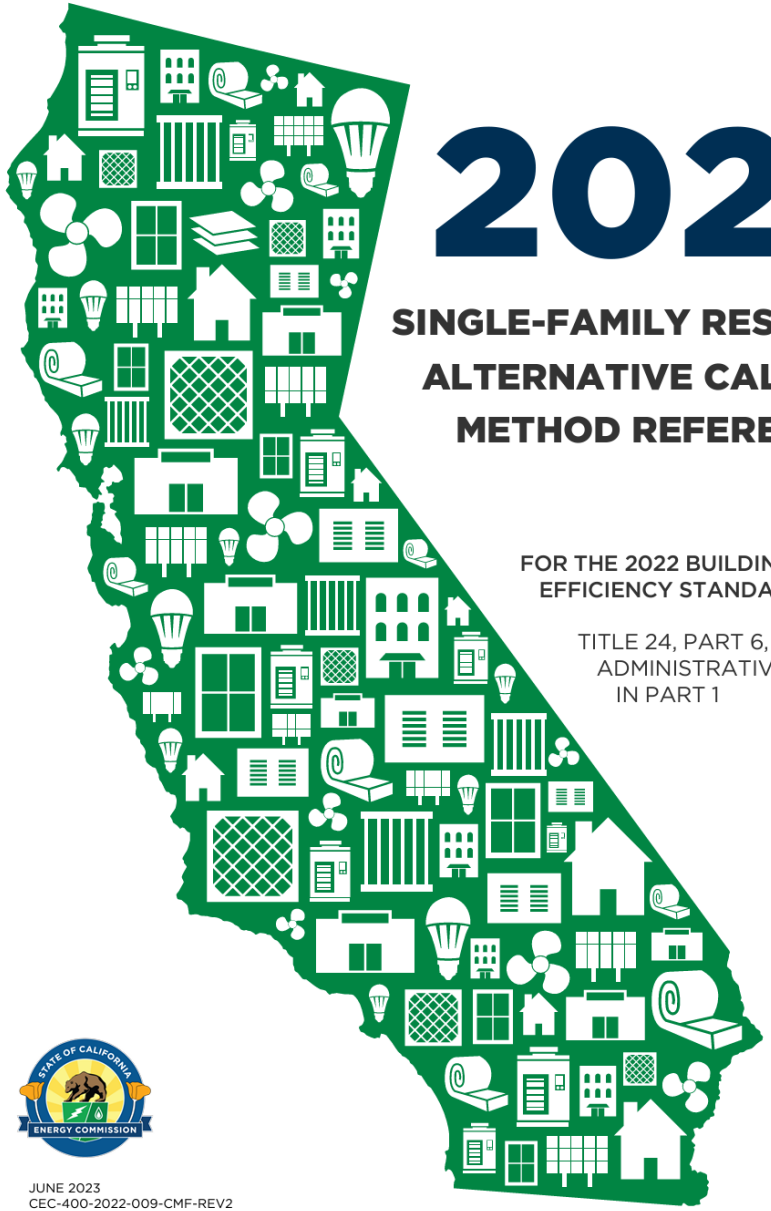
NEEP Data


0.12
0.1
0.08
0.06
0.04
0.02
0
Frequency
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
Min Capacity 47°F / Max Capacity 47°F



AHRI Rating Data

+NEEP data



2023

SINGLE-FAMILY RESIDENTIAL ALTERNATIVE CALCULATION METHOD REFERENCE MANUAL

FOR THE 2022 BUILDING ENERGY EFFICIENCY STANDARDS

TITLE 24, PART 6, AND ASSOCIATED ADMINISTRATIVE REGULATIONS IN PART 1

JUNE 2023
CEC-400-2022-009-CMF-REV2

CALIFORNIA ENERGY COMMISSION
Gavin Newsom, Governor