

# Comparing **AIR** Source & **WATER (GEO)** Source Heat Pumps

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# How ratings methods are the same, but different. Acronyms galore!!!

Engineer stuff: SEER or HSPF(btus per watt)/3.413 = COP

## -AIR SOURCE-

## -WATER SOURCE- (a.k.a. GEO)

### RATED via AHRI-210/240 - SEER & HSPF

- **SEER (cooling)** BTU transferred/Watts purchased – “Cooling number”
- **HSPF (heating)** = Adjusts “SEER” type rating for varying outdoor Entering Air Temps (EAT) & part load operation - ASHRAE (Std 114) & DOE Test (10CFR, 430)

Published data references 2,080 minimum annual run hrs –in the Carolinas or “zone 4”)

SO PUBLISHED EFFICIENCIES for HSPF & SEER are only accurate for seasonal temperatures/conditions in region 4

- \*Performance “opportunity” #s based on a MINIMUM Entering Air Temperature (EAT) exclusively in zone 4 as well as varying defrost hours and related operating conditions in zone 4 averaged seasonal conditions .

Important note for later: [Rated at 45F (best), and 17F (worst)]

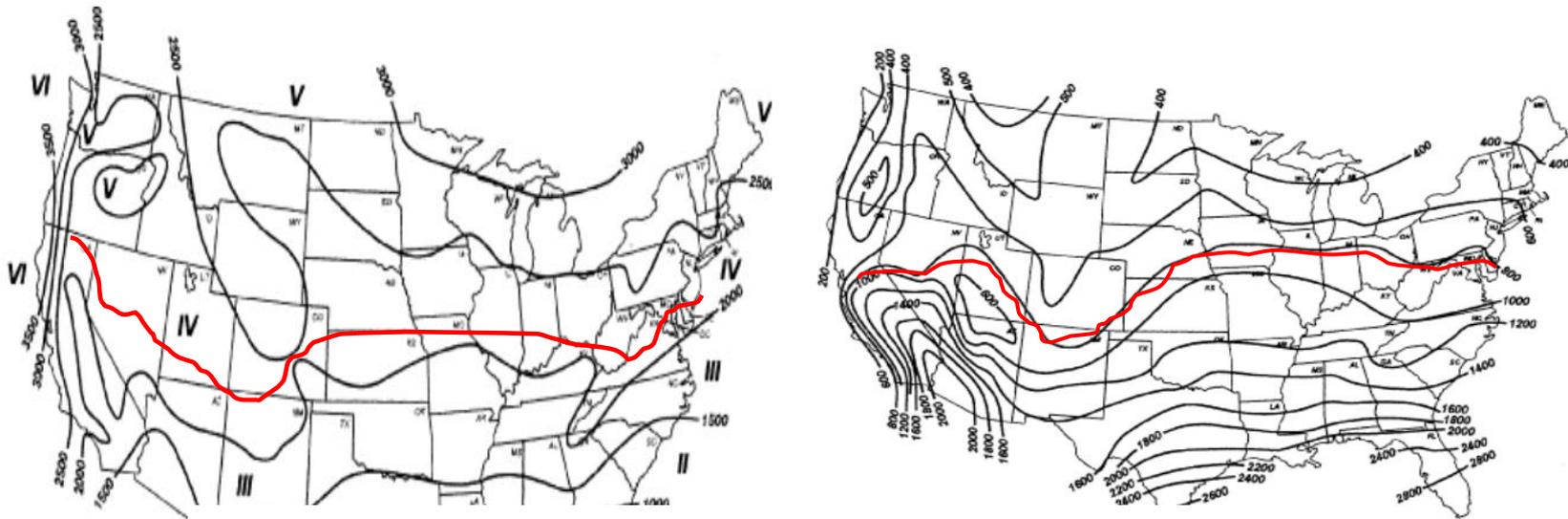
### RATED via AHRI/ISO-13256 – EER & COP

- **COP (Heating)**
- **EER (cooling)**

Geothermal at Entering Water Temp (EWT) 50°F (GWHP-Well) & 32°F (GLHP- Closed Loops)

Geo rating/performance “opportunity” based on minimum EWT and is NOT zone specific, because groundsource HX is designed/rated to maintain constant exchange deltas with the earth. Not the outdoor air!

# NATIONAL HEAT/COOL ZONES



ANSI/ANSI/AHRI STANDARD 210/240-2008

Figure 2 Heating Load I

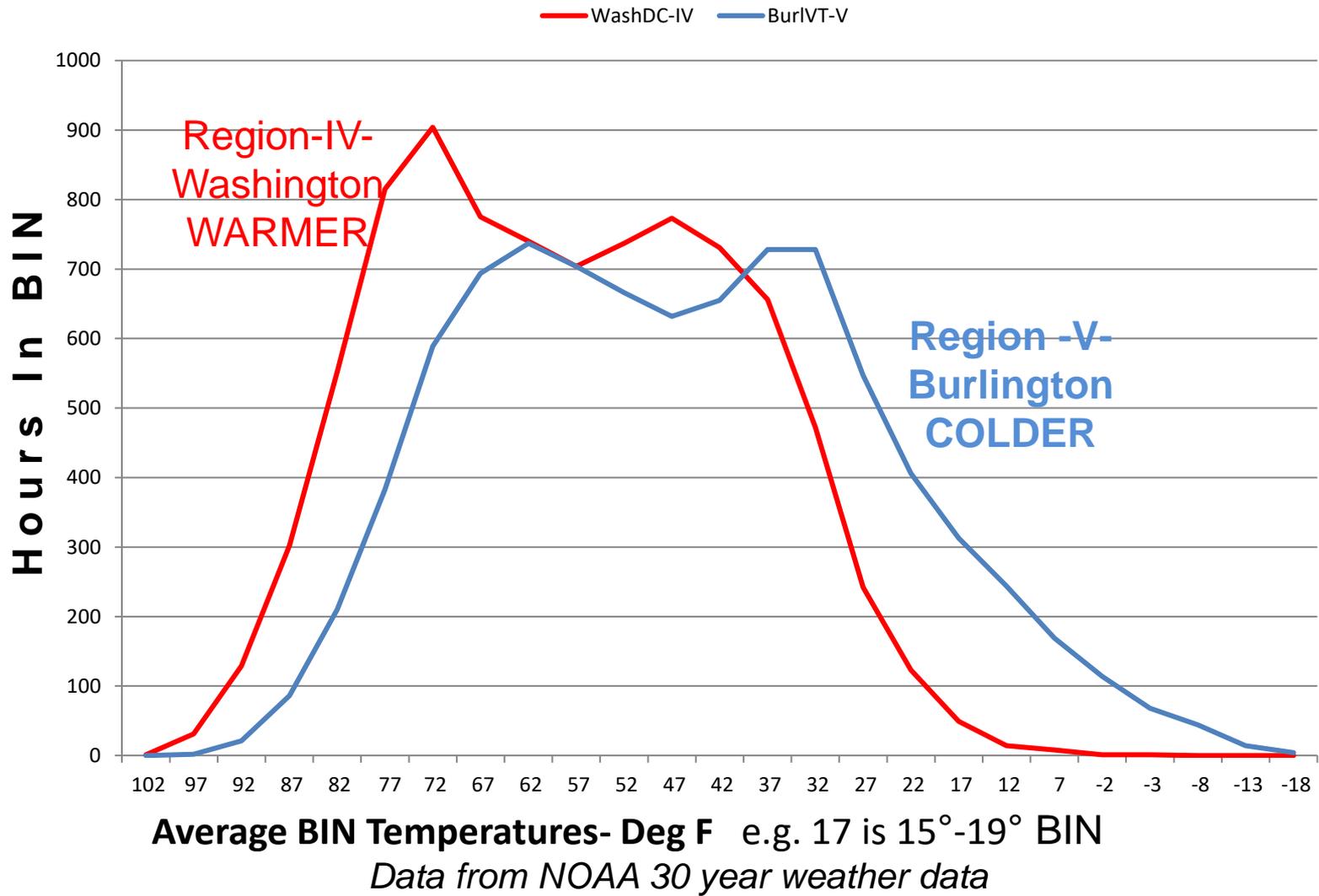
Table 19. Representative Cooling and Heating Load Hours for Each Generalized Climatic Region		
Region	CLH <sub>R</sub>	HLH <sub>R</sub>
I.....	2400	750
II.....	1800	1250
III.....	1200	1750
IV.....	800	2250
V.....	400	2750
VI.....	200	2750

Average hours (not minimum)

} 22%

4.4. Rounding of SEER, HSPF, and APF for reporting purposes. After calculating SEER according to section 4.1, round it off as specified in subpart B 430.23(m)(3)(i) of Title 10 of the Code of Federal Regulations. Round section 4.2 HSPF values and section 4.3 APF values as per §430.23(m) (3) (ii) and (iii) of Title 10 of the Code of Federal Regulations.

# Region IV vs. Region V



# Thermal “heat pumping” using, “Heat Pumps”

## Conductivity

**4X** more effective “Energy Transfer” Substance

**Air = 0.24 cal/g/°C**

**Water = 1.00 cal/g /°C**

**1. More Energy Transfer at any Temperature**

**2. Higher Overall Efficiency**

**WATER WINS by a FACTOR OF FOUR**



# COMPARITIVE EFFICIENCIES

## Manufacturer's Performance Reference



Today's Air source "label"  
performance range

\*COP of 2.0 -3.7

*translates to HSPF of 6.8 to 12.5*

(In zone 4)



Today's Geothermal "label" performance  
Range

Ratings AHRI/ISO-13256:

\*COP – 3.5 – 5.3

\*EER - 17 – 51

(No zone related  
performance/efficiency effect)

\*Under "best" exchange temp (earth or air-source) operation

# “Best” Air-source performance conditions at 45 degrees F (EAT)

HSPF to COP		Based on 68F indoor setpoint		ARI outdoor air temp for heating rating point	
Inputs ONLY	For HSPF Less than 8.5 (PSC blower)	Outside Air Temp =	45 degF	For HSPF Greater than 8.5 (ECM blower)	Outside Air Temp =
		Rated HSPF =	8		45 degF
					Rated HSPF =
					10

\*Difference = -0.2758computed

\*Difference = -0.2465computed

Adjusted HSPF  
= 10.21 computed  
at 45 degrees F

Adjusted HSPF = 12.46 computed  
at 45 degrees F

Equivalent COP = 2.99 computed

Equivalent COP = 3.65 computed



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## Climatic Impacts on Heating Seasonal Performance Factor (HSPF) and Seasonal Energy Efficiency Ratio (SEER) for Air-Source Heat Pumps

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Matthew Lombardi

# Adjusted Air-source performance at 30 degrees F (EAT)

## HSPF to COP

Based on 68F indoor setpoint

### Inputs

For HSPF Less than 8.5 (PSC blower)

For HSPF Greater than 8.5

(ECM blower)

### ONLY

Outside Air Temp = **30** degF

Outside Air Temp = **30** degF

Rated HSPF = **8**

Rated HSPF = **10**

\*Difference = -0.0285 computed

\*Difference = 0.0162 computed

Adjusted HSPF = **8.23** computed

### Adjusted

HSPF = **9.84** computed

at 30 degrees F

at 30 degrees F

Equivalent COP = **2.41** computed

Equivalent COP = **2.88** computed

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# Adjusted Air-source performance at 0 degrees F

## HSPF to COP

Based on 68F indoor setpoint

### Inputs

For HSPF Less than 8.5 (PSC blower)

For HSPF Greater than 8.5

(ECM blower)

### ONLY

Outside Air Temp = 0 degF

Outside Air Temp = 0 degF

Rated HSPF = 8

Rated HSPF = 10

\*Difference = 0.3216computed

\*Difference = 0.3858computed

Adjusted HSPF = 5.43 computed  
at 0 degrees F

Adjusted HSPF = 6.14 computed  
at 0 degrees F

Equivalent COP = 1.59 computed

Equivalent COP = 1.80 computed



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# Factors that effect performance of Air-source and Geo Heat Pumps

## Air source

- “Label” Model Efficiency - SEER and HSPF
- Operating temperate “Zone” (EAT) and defrost cycle/resistance heat assist profile factors (required)
- Run hours – Load to capacity ratio
- Installation method – Duct pressure, line sizing, placement
- Electric “parasites” supporting compressor activity (blowers inside and outside)
- Other DELTAS of temperature and pressure in extraction and delivery

## Groundsource

- “Label” Model Efficiency - EER and COP
- Earth-coupling type/method
- Entering Water/Fluid Temperature from earthside
- Run hours – Load to capacity ratio
- Electric “parasites” supporting compressor activity (blowers, circulators, etc.)
- Other DELTAS of temperature and pressure in extraction and delivery