Phoenix ENERGY SUPPLY

Presents

Trench Talk

The Nitty-Gritty of Geothermal Design & Installation

An Educational Series of Webinars to Sharpen the Skillls in the Art of Geothermal System Design, Installation and Service

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## Trench Talk

A series of live webinars to serve the geothermal community

# Hydronic System Design

Tuesday May 10, 2022, 4 PM EDT

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The Nitty-Gritty of Geothermal Design & Installation

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## Agenda

- The Secret to Life
- LLT Impact
- Choices & Consequences
- Direct to Load
- Single Speed vs Variable Speed
- Steady-State vs Cycling
- Outdoor Reset
- Q&A

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## The Secret to Life

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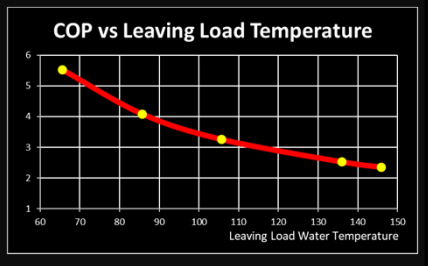
## Why Temperature is Important

The difference between 120°F LLT (COP=2.9) & 93°F LLT (COP = 3.6) is a 19.4% drop in efficiency. From 140°F LLT to 93°F LLT is a 33.3% drop in efficiency.

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## ...and what dictates Supply Water Temperature?

a) Sunspots
b) The mood of the homeowner
c) The utility company
d) NYSERDA
e) The **System Designer** that must understand the heat transfer characteristics of each of the heat emitters in the hydronic system

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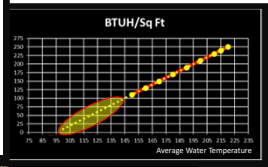
## Cast Iron Radiator

**19"H x 14"L x 4 1/2"W, 4 Tubes, 8 Sections**

| AV. WATER TEMP. IN RADIATOR | 220° | 215° | 210° | 200° | 190° | 180° | 170° | 160° | 150° |
|---|---|---|---|---|---|---|---|---|---|
| HEAT EMISSION BTU PER SQ. FT. | 250 | 240 | 230 | 210 | 190 | 170 | 150 | 130 | 110 |




From a Nominal Rating of 250 @ 220ºF Average WT in a geothermal application the output will be reduced to a Maximum Output of 100 BTUH/Sq Ft – at best a 60% lower output.

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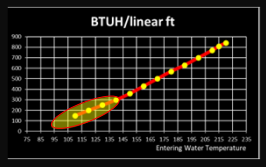
## Finned Tube Baseboard

**copper tubing, with 2-5⁄8" x 2-1⁄8" x .009" aluminum fins, bent to 2-19⁄64" x 2-1⁄8" or 2-5⁄16" x 2-1⁄8", spaced 56.35 per linear foot**

| HOT WATER RATINGS: BTU/HR. per linear ft. with 65˚F entering air | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 110˚F | 120˚F | 130˚F | 140˚F | 150˚F | 160˚F | 170˚F | 180˚F | 190˚F | 200˚F | 210˚F | 215˚F | 220˚F |
| 150˚ | 200˚ | 250˚ | 300˚ | 360 | 430 | 500 | 570 | 630 | 700 | 770 | 810 | 840 |




Ratings are based on active finned length (5" to 6" less than overall length)

From a Nominal Rating of 840 @ 220ºF EWT in a geothermal application the output will be reduced to a Maximum Output of 300 BTUH/Sq Ft – at best a 65% lower output.

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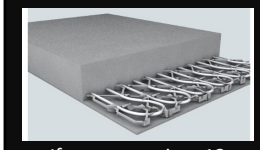
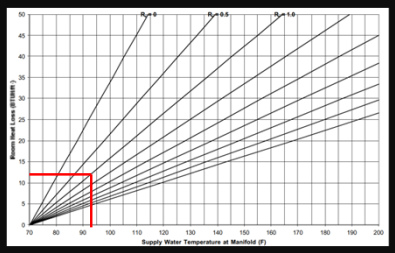
## High Mass Radiant

**4" Concrete Slab, 65 F Room Temperature - 3/4", 5/8", 1/2" & 3/8" Tubing - 6" On Center, 10-degree supply / return temperature differential**






If space requires 12 Btuh/sq ft & Floor Covering has R=1.0 the EWT needs to be 93ºF

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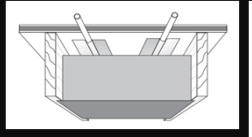
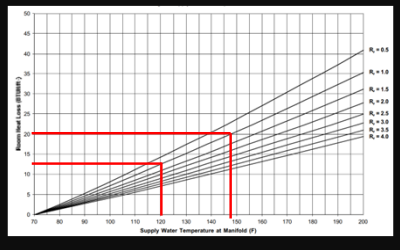
## Staple-Up Radiant

**Joist Cavity with 3/4" Plywood Subfloor, 65 F Room Temperature - 3/4", 5/8" & 1/2" Tubing - 8" On Center, 10-degree supply / return temperature differential**






If space requires 12 Btuh/sq ft & Floor Covering has R=1.0 the EWT needs to be 120ºF

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## Design LLT Impact

**60,000 BTUH Design Heating Load**

| Design LLT Impact | | |
|---|---|---|
| Design LLT | KWH | % |
| 100 | 8,939 | 100% |
| 120 | 10,629 | 119% |
| 140 | 12,009 | 134% |

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## Design LLT Impact

60,000 BTUH Design Heating Load

| Design LLT Impact | | | Outdoor Reset | |
|---|---|---|---|---|
| Design LLT | KWH | % | KWH | % |
| 100 | 8,939 | 100% | 7,886 | 88% |
| 120 | 10,629 | 119% | 8,810 | 99% |
| 140 | 12,009 | 134% | 9,478 | 106% |

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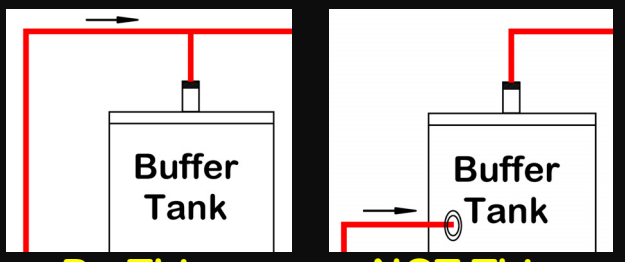
## Direct-to-Load

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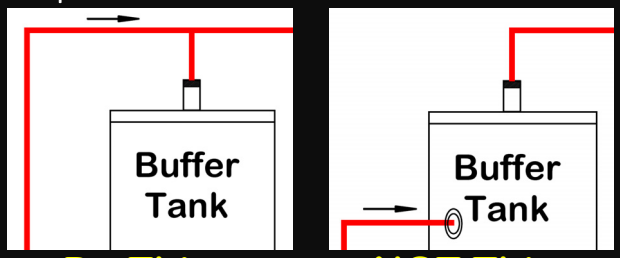
## I Repeat.....

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## ANY QUESTIONS

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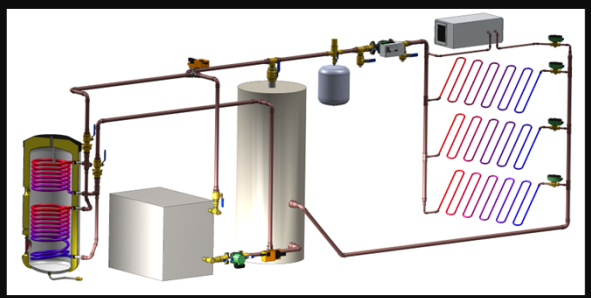
## Direct to Load



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It makes no sense to send the hottest water in the system (leaving the heat pump) back to the buffer tank where it will be thermally diluted before going to serve the heating load. A loss of 8-10 degrees will force the heat pump to operate at higher LLT to allow the distribution system to deliver the required amount of heat.

And we know that Supply Water Temperature is the Secret to Life.

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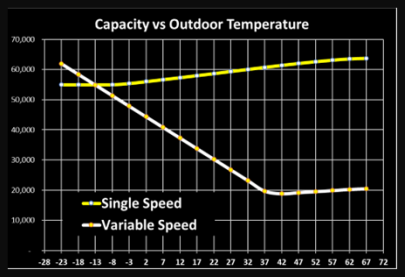
## Single Speed vs Variable Speed




- When heating capacity exceeds what's required the equipment will cycle on & off.
- Cycling equipment is not as efficient as it is when running continuously (steady state).
- All AHRI COP ratings are done for steady state operation.

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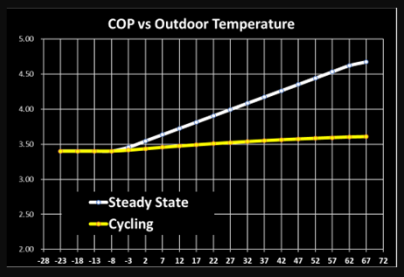
## Steady State vs Cycling Efficiency

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- SEER was developed for air source to try and capture the degradation in efficiency associated with cycling.
- Degradation Coefficient – $C_d$
- And where do we spend the bulk of the time heating?

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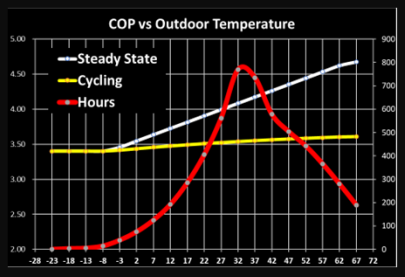
## Steady State vs Cycling Efficiency

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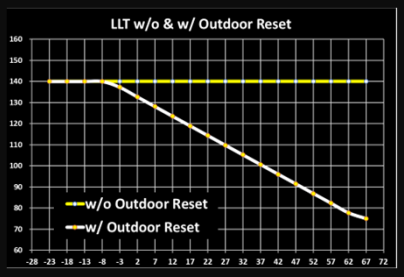
## Outdoor Reset




- Outdoor Reset lowers the Leaving Load Temperature (LLT) as Outdoor temperatures are warmer.
- A lower LLT will result in higher efficiency & less stress on the compressor.
- In terms of KWH reduction, this can be quite significant.

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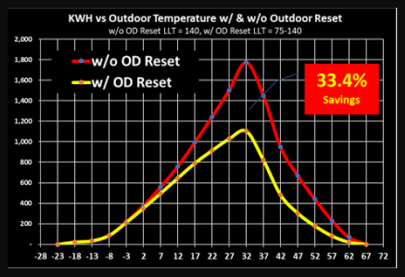
## Outdoor Reset

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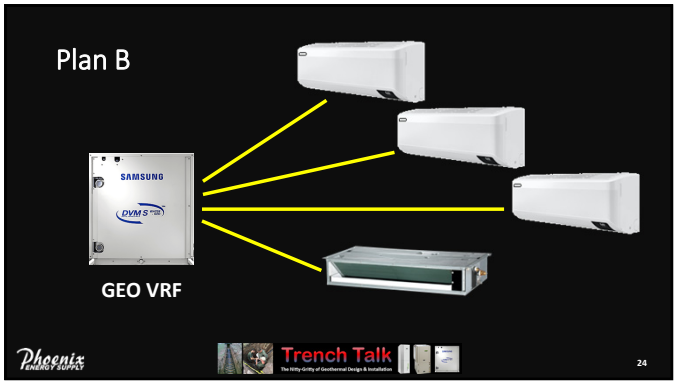
Plan B
SAMSUNG
DVM S
GEO VRF
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Q&A
Please complete our short evaluation Poll
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