



Transitioning to Low-Temperature Hydronic Heating

Presented by: Doug Andrade and Mark LaFrance

April 2, 2026

Hosted by:



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Doug Andrade

HTS New England

New Hampshire Technical Institute – Mechanical Engineering Technology

Core role at HTS is working as the Heating Product Specialist

Likes music and classic cars



ML1

Mark LaFrance

HTS New England

University of New Hampshire - Mechanical Engineer

Core role at HTS is supporting Consulting Engineers with HVAC equipment applications

Likes long walks at HVAC trade shows, and cars

Agenda

- **Part 1 – Where are we going, why, and how do we get there?**
- **Part 2 – Limitations of existing heating systems**
- **Part 3 – Making the transition from high-temp to low-temp**
- **Part 4 – Deeper dive into low-temp HW terminal equipment**



Before we start!

Temperature Definitions

- **High-temperature** hot water: 160-200F (Typical: 180F)
- **Medium-temp** hot water: 130-150F (Typical: 140F)
- **Low-temp** hot water: 100-120F (Typical: 120F)



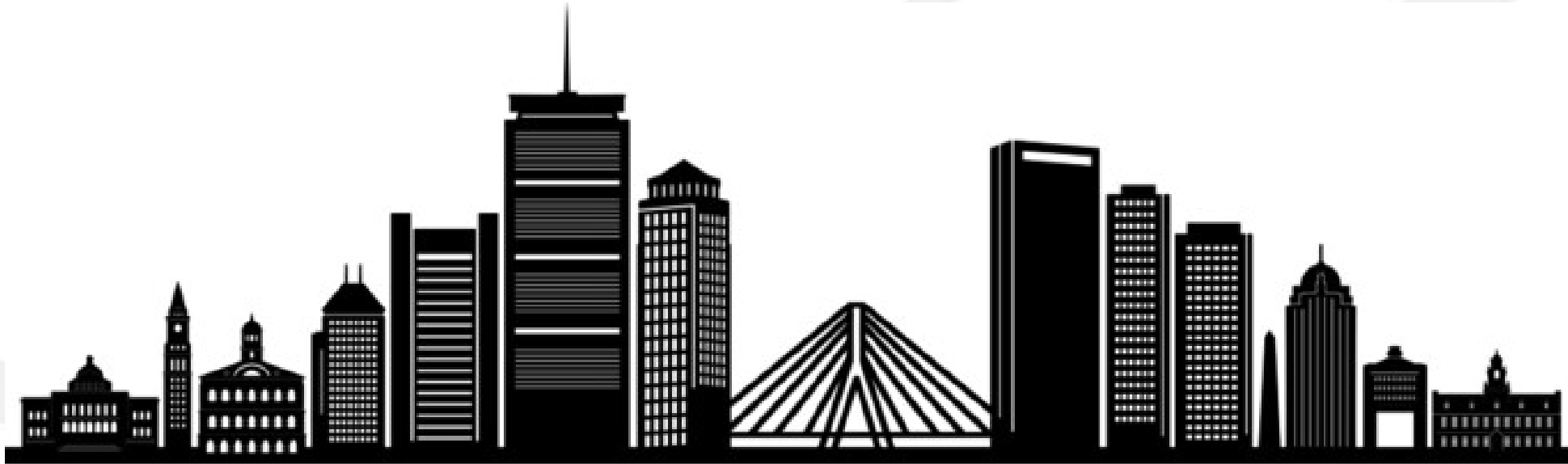
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- **Part 1 – Where are we going, why, and how do we get there?**
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Existing Buildings

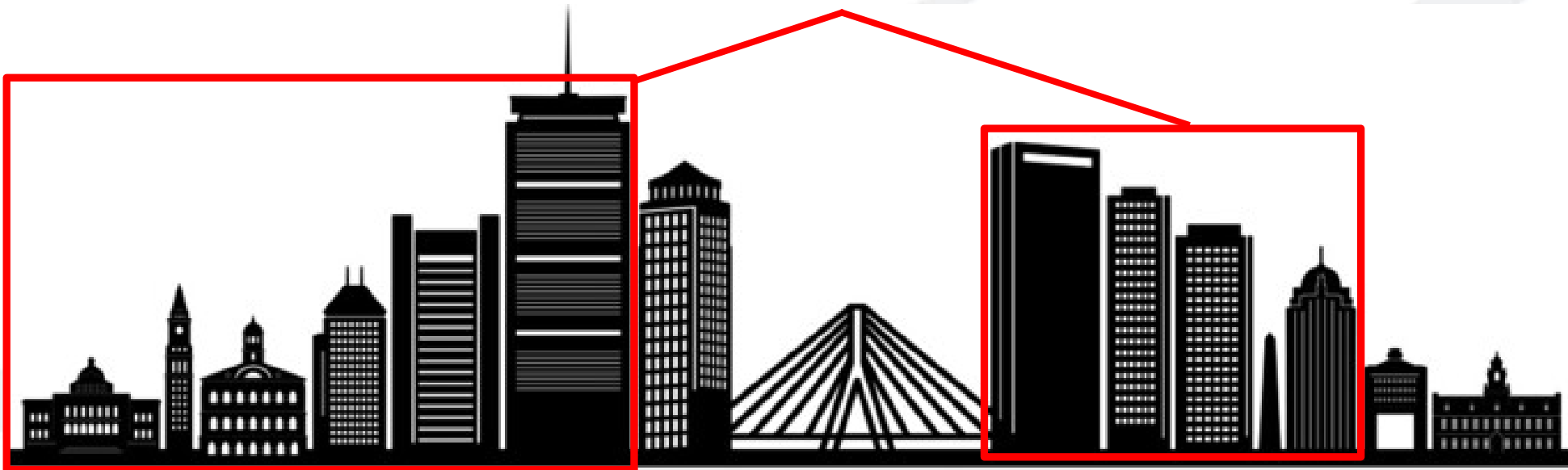
An estimated 70% of buildings in Boston were designed to use high-temp HW



Existing Buildings

80% of the predicted building stock for 2050 are buildings that exist today

These exist today!

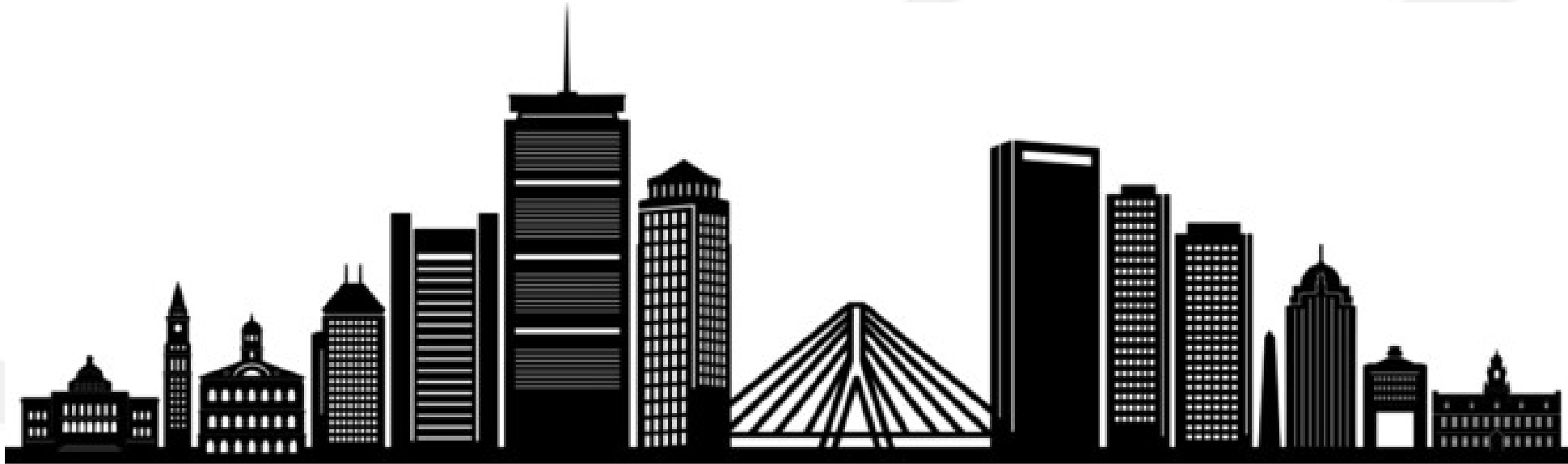


Circa 2050



Existing Buildings

We need solutions for decarbonizing our *existing* buildings.



Ways to Electrify / Decarbonize Heating Systems

- **Electric boilers**

- Benefits: minimal equipment
- Challenges: large electrical requirements, COP = 1



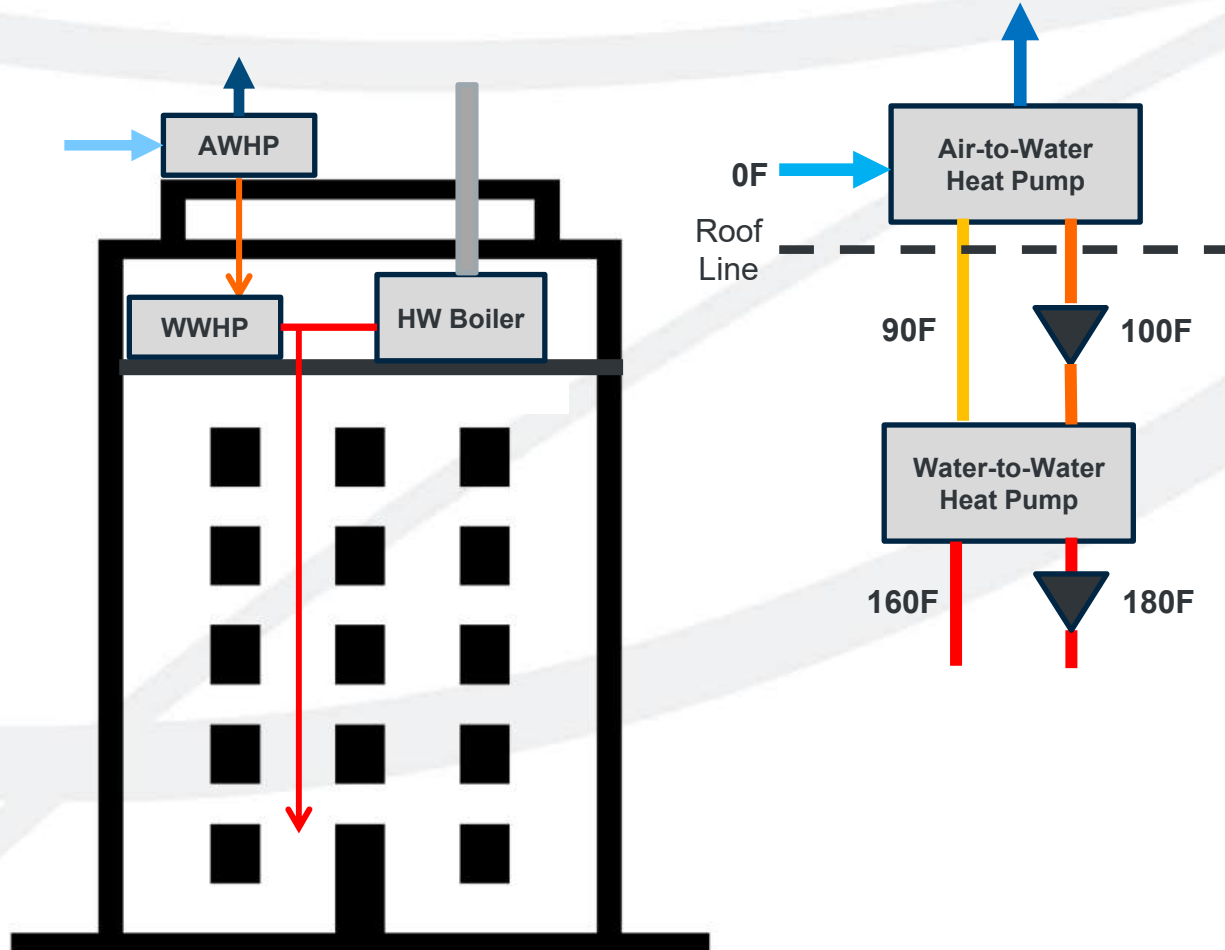
- **Heat pumps**

- Benefits: higher-efficiency (COP = 2-2.5)
- Challenges: high upfront cost, more complexity, more space required



Ways to Electrify / Decarbonize

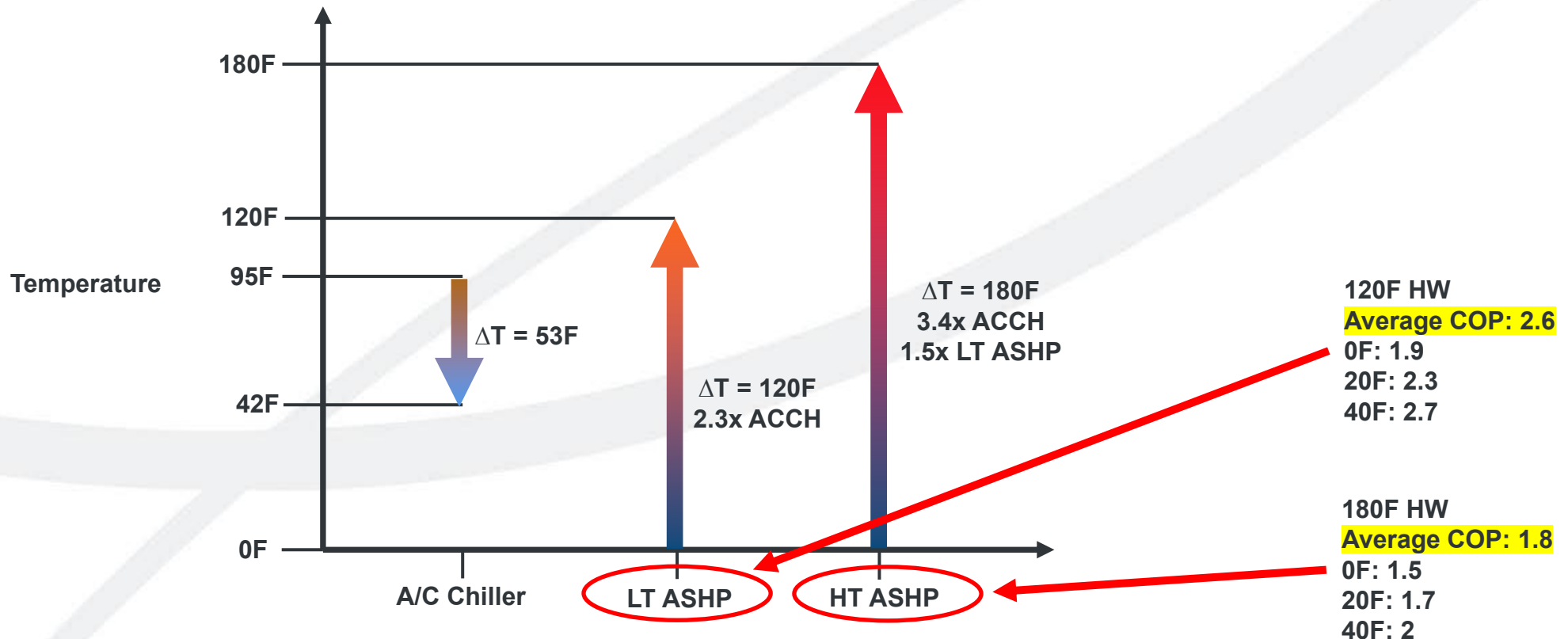
Can I get 180F HW with an ASHP?



Ways to electrify / decarbonize

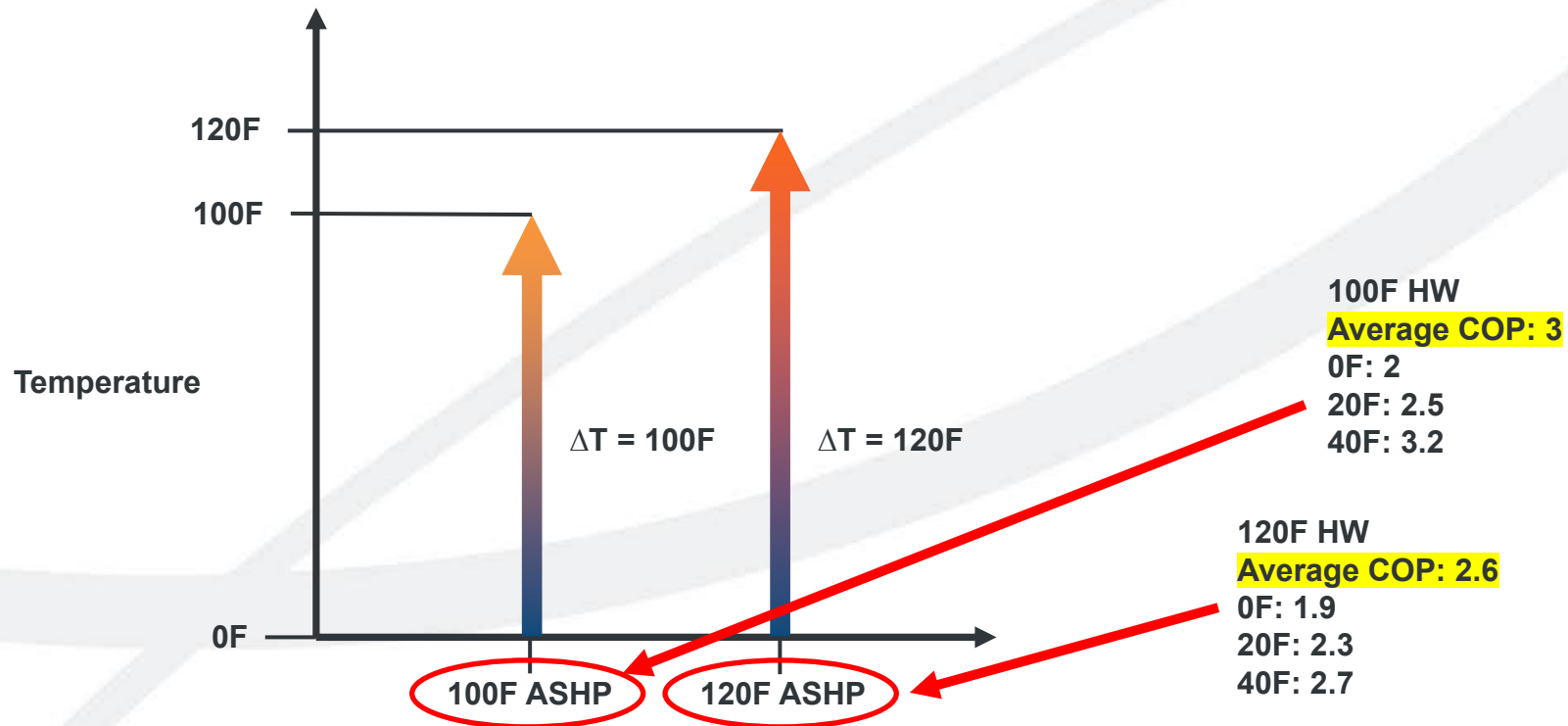
Does it make sense to make 180F HW with an ASHP?

There are caveats. We can't cheat physics.

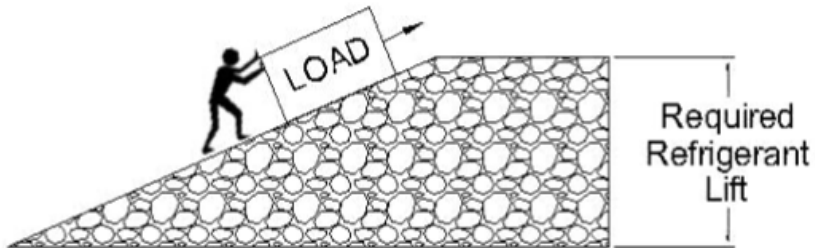
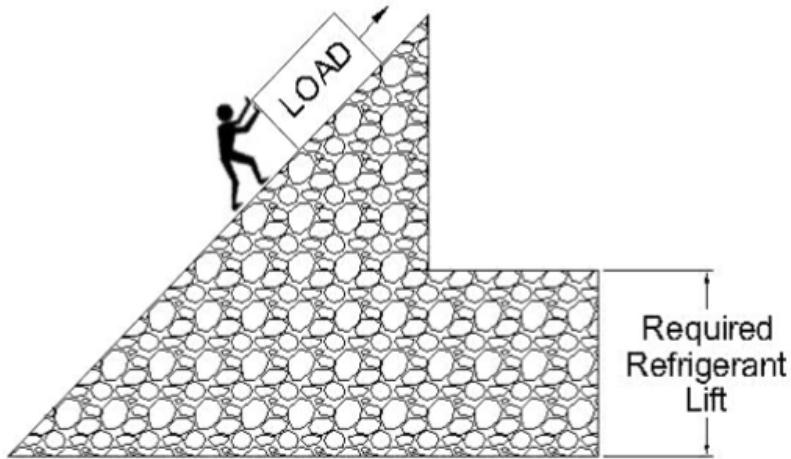


Where hydronic heating systems *can* be

Low-temp HW Heat pumps: COP = 2.5-3



Water Temperature vs. Efficiency



Only do as much lift as needed

At 40F ambient:

140F HW: COP = 2.17

130F HW: COP = 2.37

120F HW: COP = 2.60

110F HW: COP = 2.86

100F HW: COP = 3.15

16%
Energy
Savings

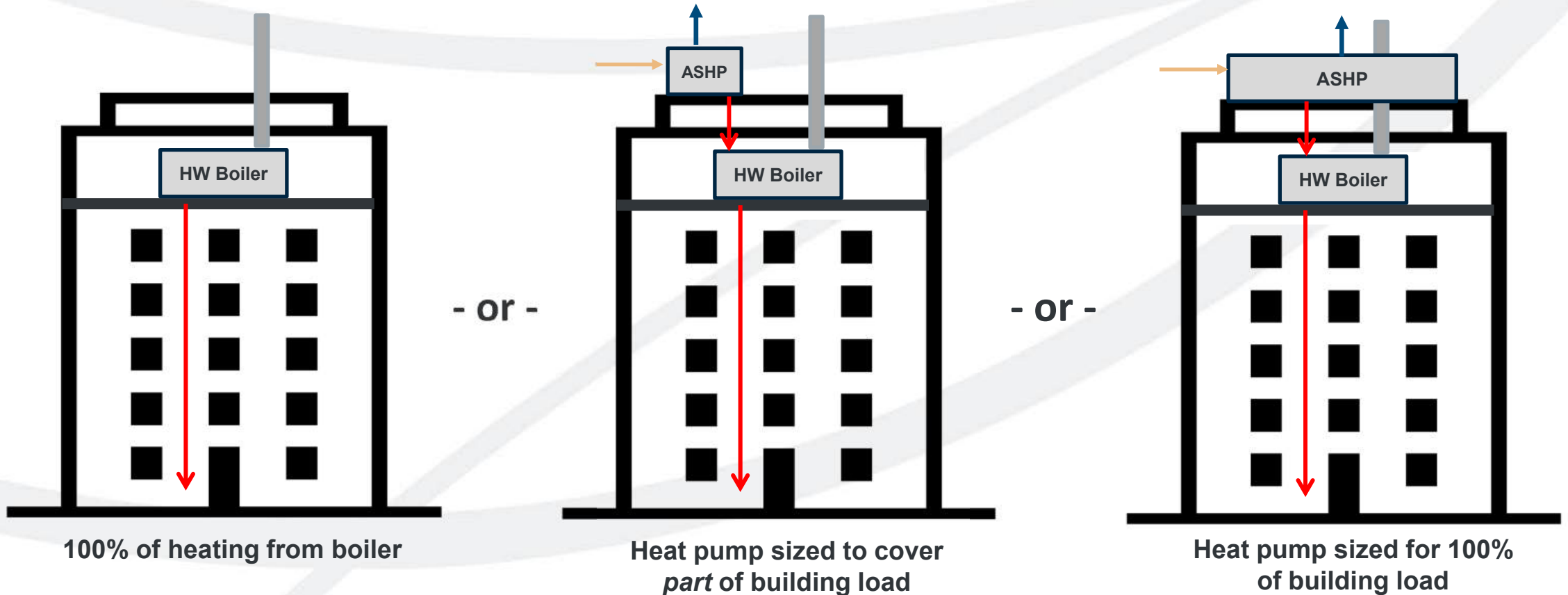
17%
Energy
Savings

31%
Energy
Savings

Lower temp = higher efficiency

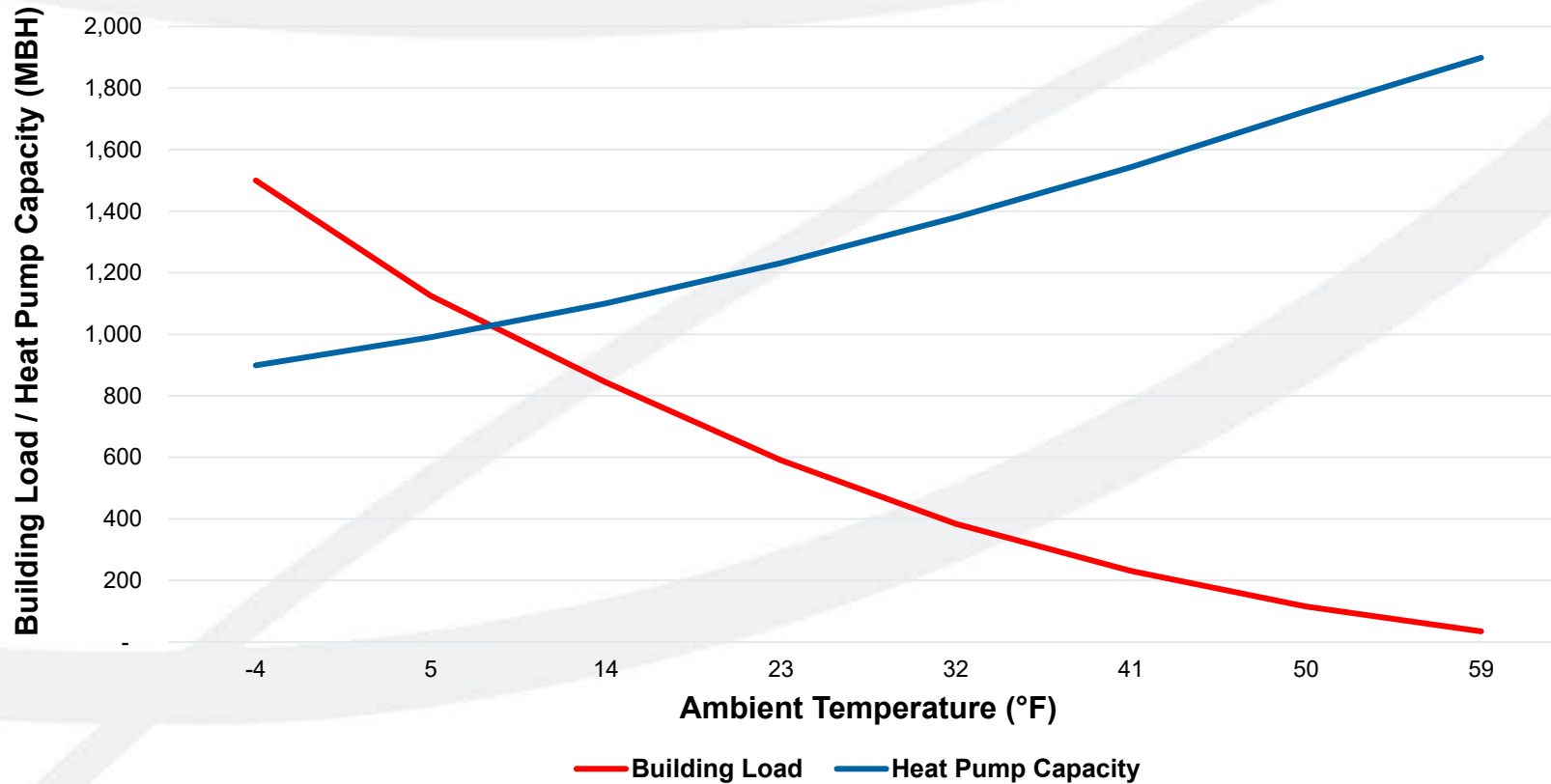


Electrification Options – How Much Heat Pump?

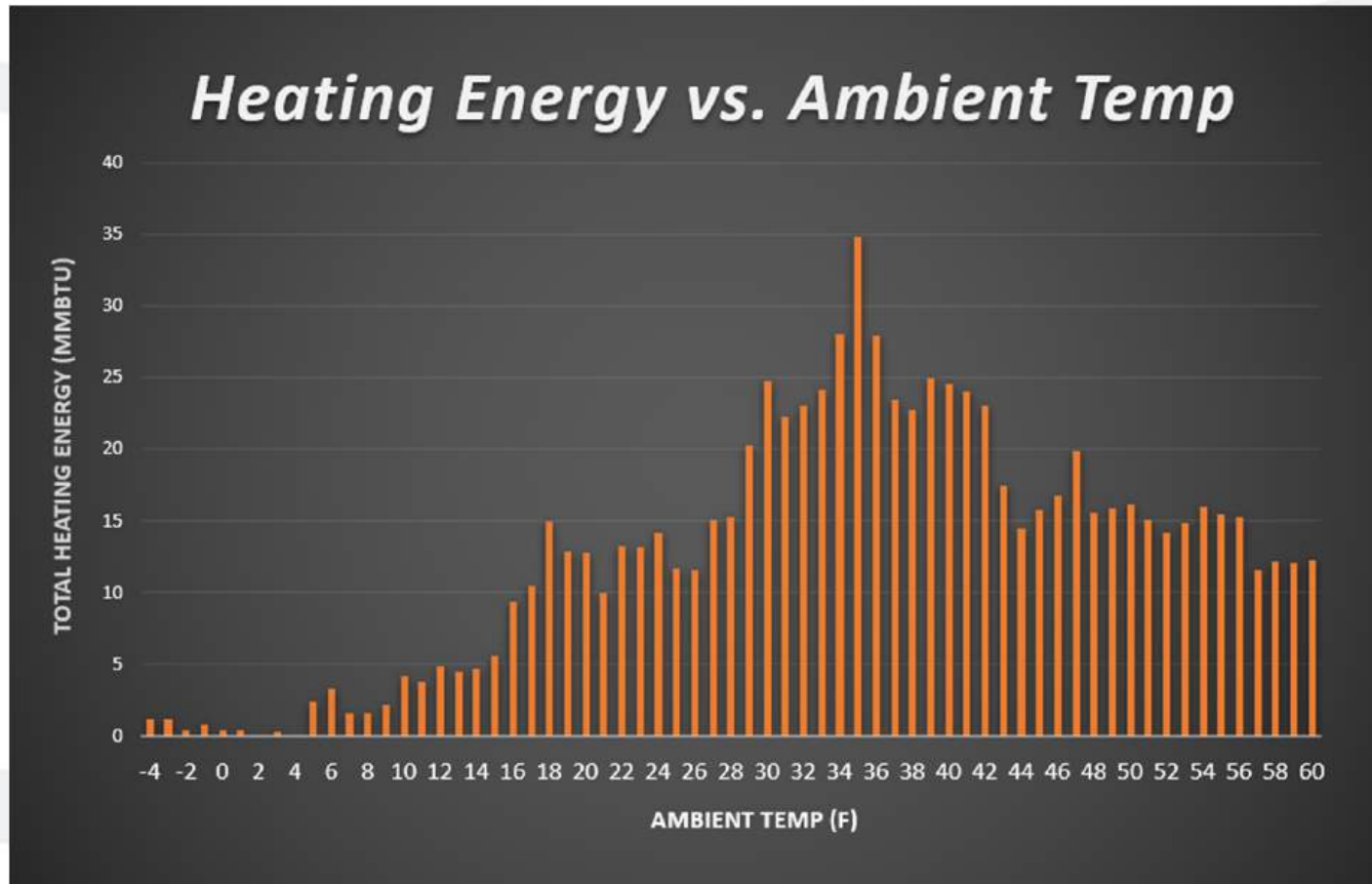


Building Heating – Air-to-Water Heat Pumps

Building Load vs. Heat Pump Capacity



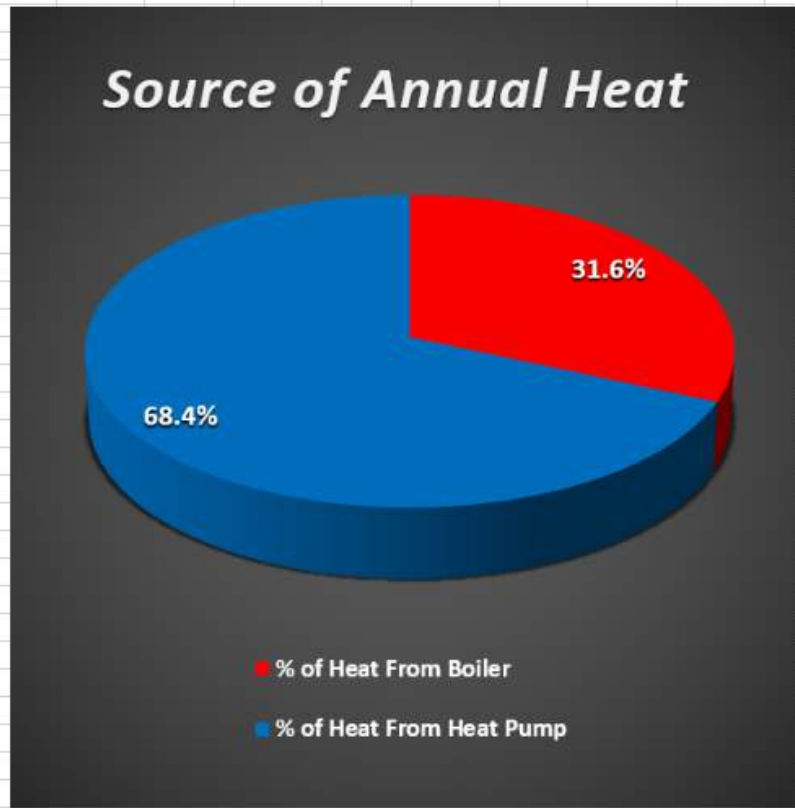
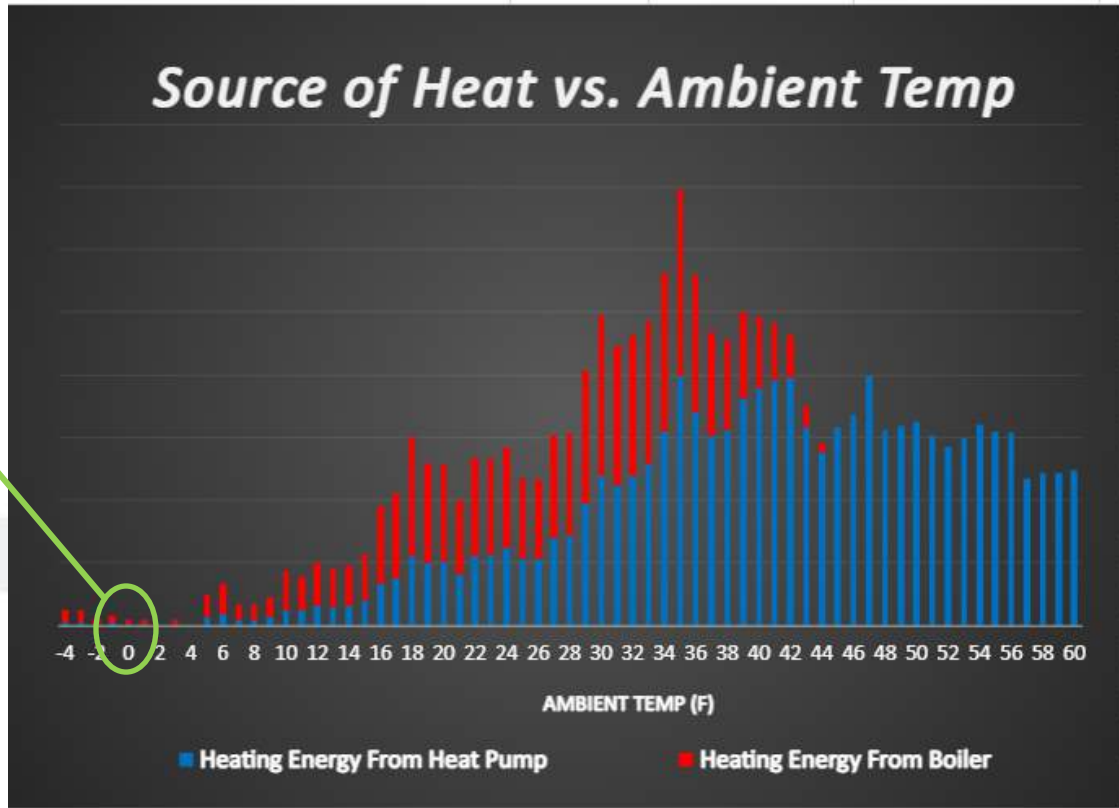
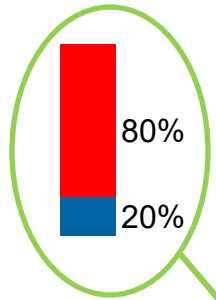
Building Heating – Air-to-Water Heat Pumps



Building Heating – Air-to-Water Heat Pumps

What if we cover *part* of the load with ASHP's?

| % of Total Load Provided By Heat Pump at 0F | % Decarb |
|---|----------|
| 20% | 68.4% |

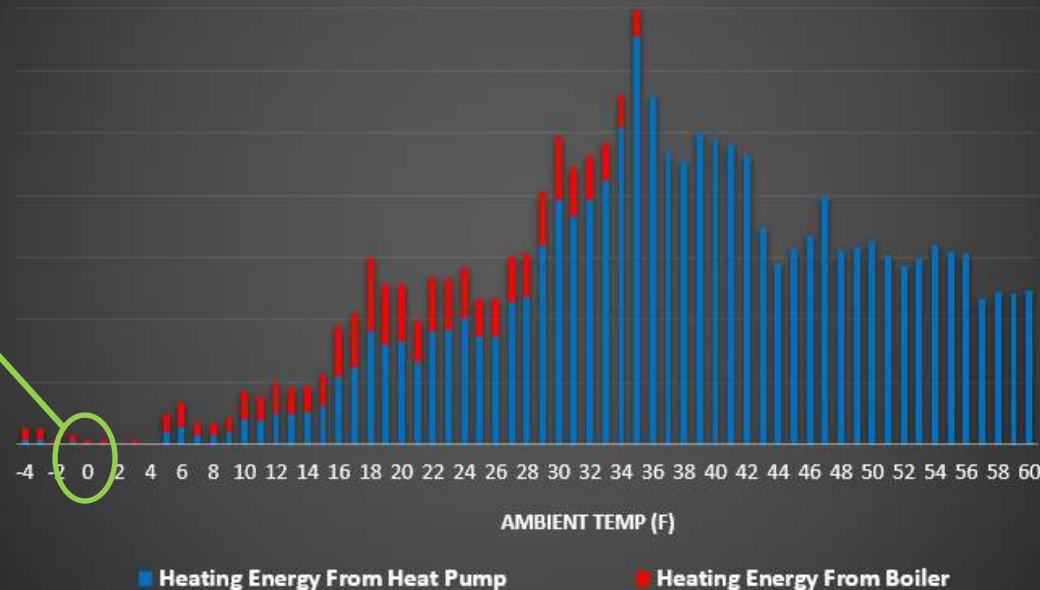


Building Heating – Air-to-Water Heat Pumps

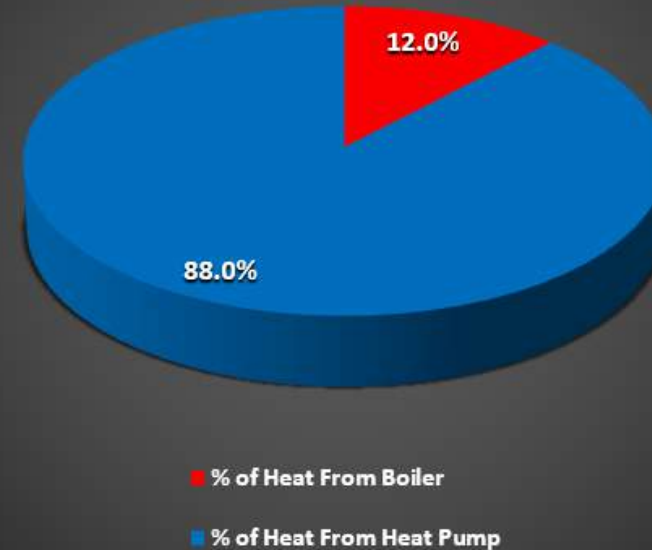
What if we cover *part* of the load with ASHP's?

| % of Total Load Provided By Heat Pump at 0F | % Decarb |
|---|----------|
| 33% | 88.0% |

Source of Heat vs. Ambient Temp

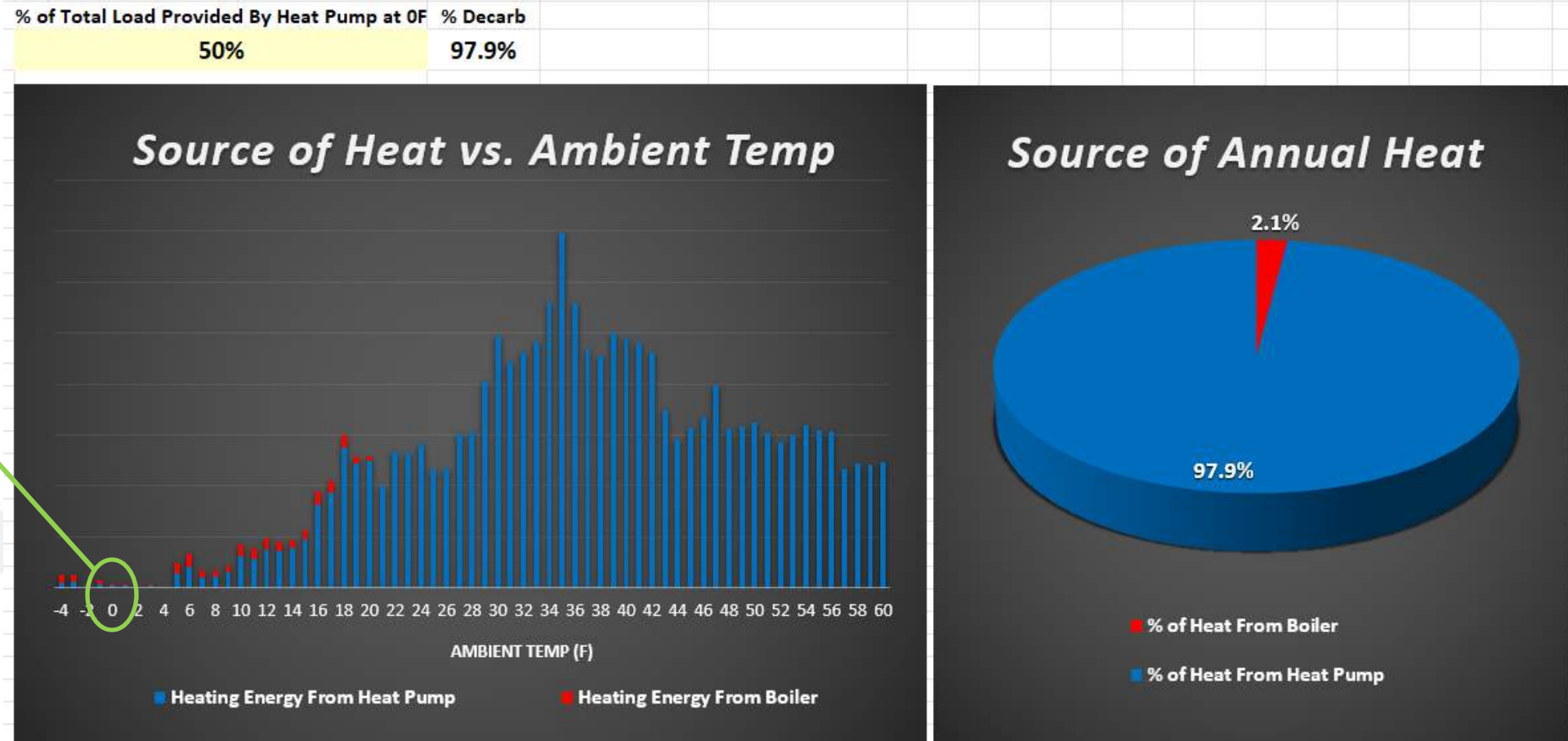


Source of Annual Heat



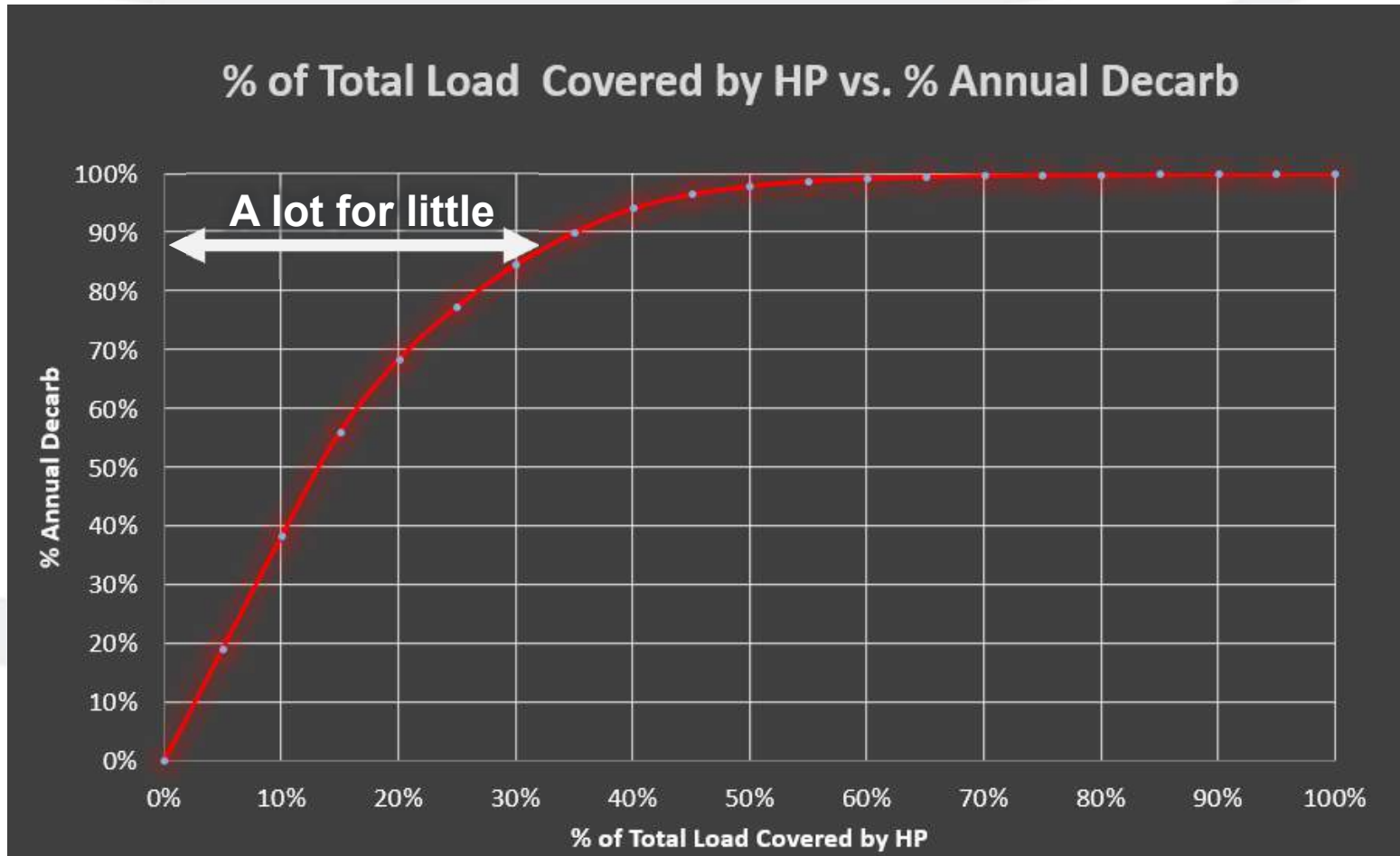
Building Heating – Air-to-Water Heat Pumps

What if we cover *part* of the load with ASHP's?

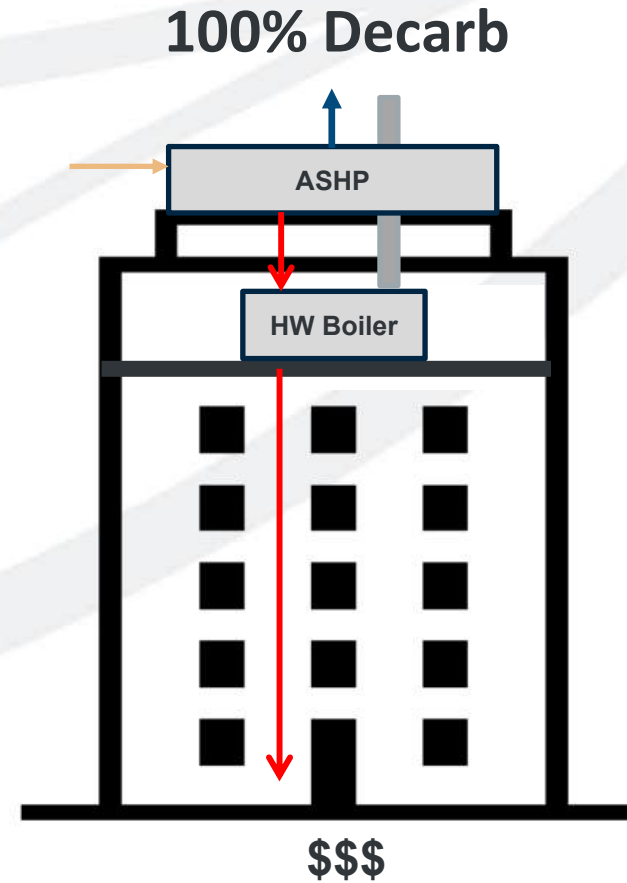
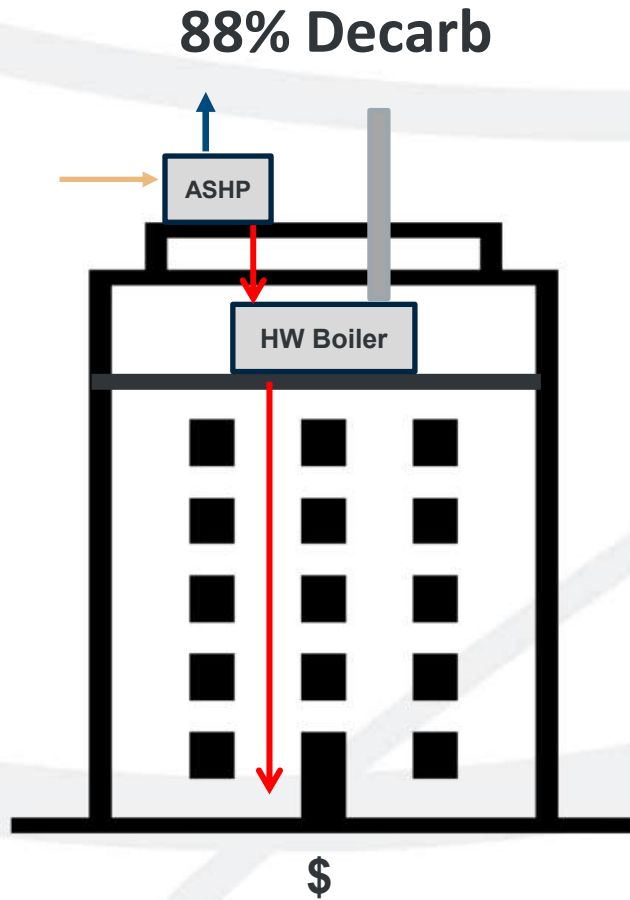


Building Heating – Air-to-Water Heat Pumps

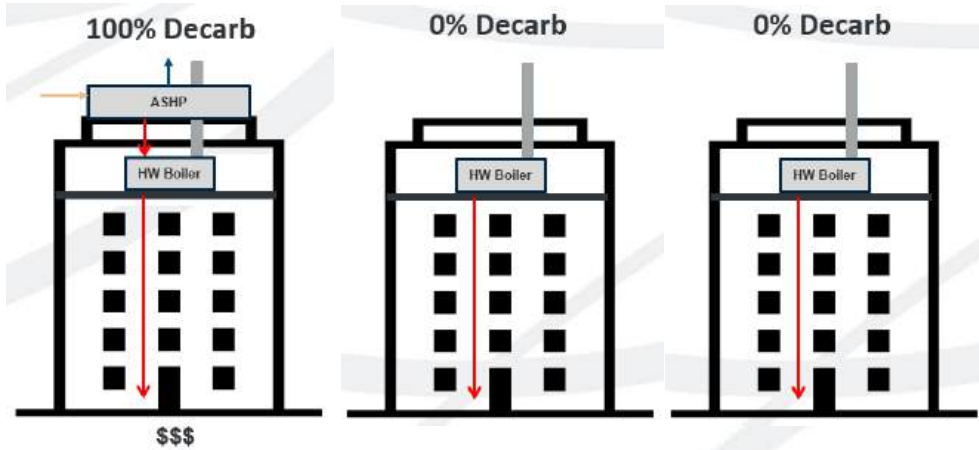
What if we cover *part* of the load with ASHP's?



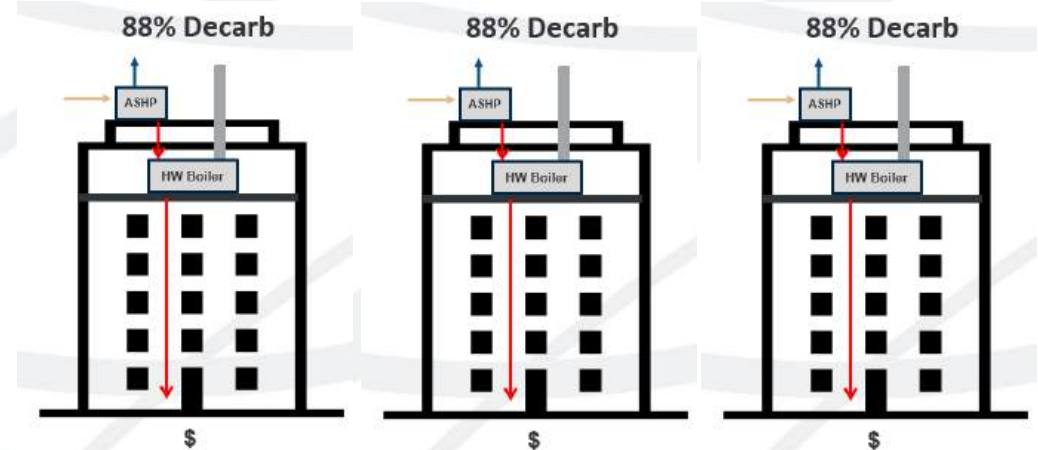
Capital Equipment vs. Value



Capital Equipment vs. Value



33% Total Decarb



88% Total Decarb

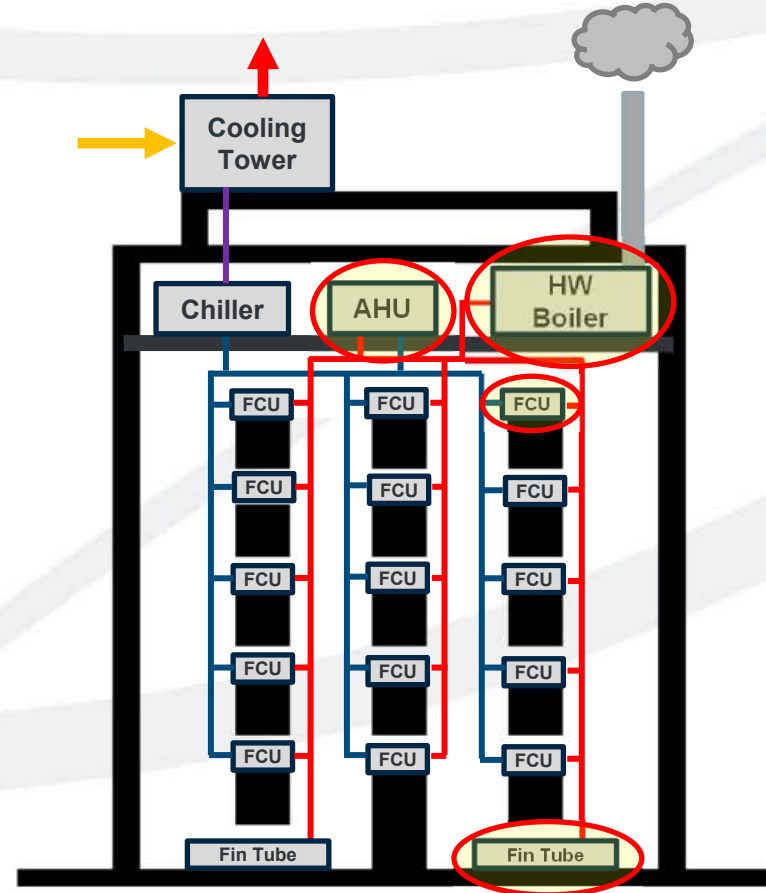


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Limitations of existing heating equipment



What if we...turn the setpoint temp to 120F?!

Existing equipment will not maintain original heat output

Heat flex Average is a function of average water temp - air temp

› $180/160 = 170\text{F} - 65\text{F} = 105\text{F}$

› $120/100 = 110\text{F} - 65\text{F} = 45\text{F}$

› $45 / 105 = 43\%$

Might maintain building when heating load is <40%



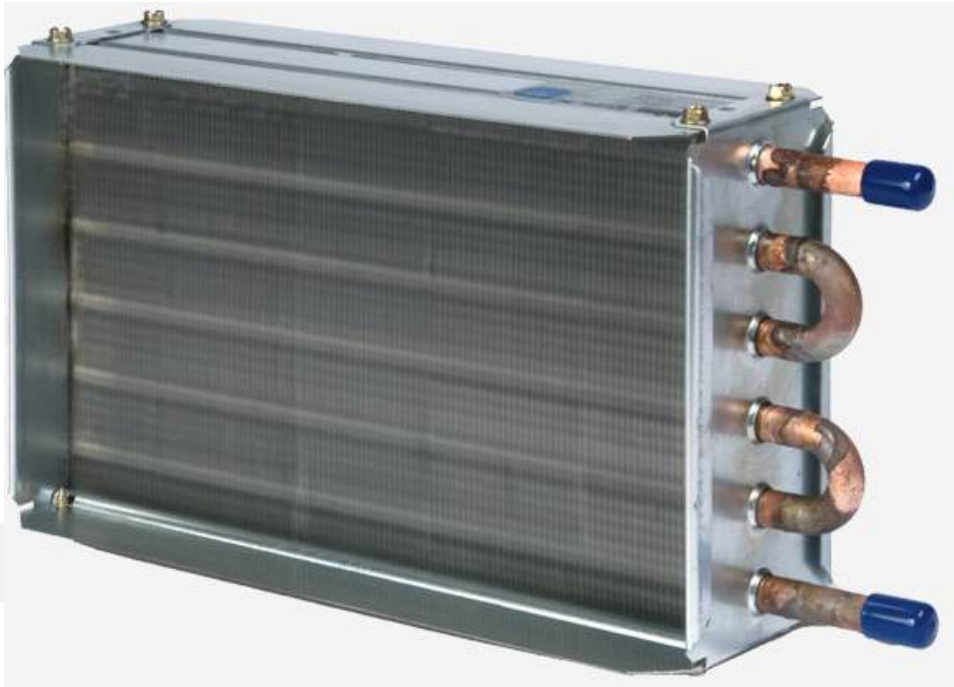
What if we...turn the setpoint temp to 120F?!

- **Non-condensing boilers become *condensing* boilers**
 - Condensation needs to be managed/collected/drained
 - Condensation is highly acidic
 - › Non-condensing boilers do not use corrosion-resistant materials (stainless steel)
 - › Non-condensing boiler chimneys are not designed for sustained condensation – especially not acidic condensation
 - This will promptly lead to significant damage, and ultimately, failure
 - **Need to keep return water >140F**



Limitations of existing heating equipment

Air Handling Unit Coils



| Performance | | | | | |
|--------------------------------------|--------------------|---------------------------|------------------------------|-------------------------|---|
| Air Flow CFM | Altitude ft | | Face Area ft ² | Face Velocity ft/min | |
| 7500 | 0 | | 15.0 | 500.0 | |
| Total Capacity Btu/hr | Temperature | | | | Air Pressure Drop inH ₂ O |
| | Entering | | Leaving | | |
| | Air Dry Bulb °F | Water °F | Air Dry Bulb °F | Water °F | |
| 330236 | 45.0 | 180.0 | 85.3 | 160.0 | 0.12 |
| Pressure Drop ft H ₂ O | Flow rate gpm | Fluid Velocity ft/s | | Type | Volume gal |
| 13.8 | 32.8 | 5.8 | | Water | 3.00 |

| Performance | | | | | |
|--------------------------------------|--------------------|---------------------------|------------------------------|-------------------------|---|
| Air Flow CFM | Altitude ft | | Face Area ft ² | Face Velocity ft/min | |
| 7500 | 0 | | 15.0 | 500.0 | |
| Total Capacity Btu/hr | Temperature | | | | Air Pressure Drop inH ₂ O |
| | Entering | | Leaving | | |
| | Air Dry Bulb °F | Water °F | Air Dry Bulb °F | Water °F | |
| 180635 | 45.0 | 120.0 | 67.0 | 109.0 | 0.12 |
| Pressure Drop ft H ₂ O | Flow rate gpm | Fluid Velocity ft/s | | Type | Volume gal |
| 15.8 | 32.8 | 5.8 | | Water | 3.00 |

55% of original capacity

Limitations of existing heating equipment

Perimeter Fin Tube



| ELEMENT | WATER FLOW | PRESSURE DROP† | 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 |
| NO. 30-75 Baseboard with 3/4" E-75 element | 1 GPM | 47 | 160* | 210* | 260* | 320* | 380 | 450 | 510 | 580 | 640 | 710 | 770 | 810 | 840 |
| | 4 GPM | 525 | 160* | 220* | 270* | 340* | 400 | 480 | 540 | 610 | 680 | 750 | 810 | 860 | 890 |

https://www.slantfin.com/images/stories/Technical-Literature/ratings_fineline30_r.pdf?utm_source=chatgpt.com

31% of original capacity

Limitations of existing heating equipment

Fan Coil Units



| Hot Water Preheat Coil | | | | | |
|------------------------|--------------------------|---------------|-----------------------------------|------------------|-----------------------------------|
| Physical | | | | | |
| Fins per Inch | Number of Rows | Coil Circuits | Face Area | Face Velocity | Connections |
| 12 | 1 row, Standard Capacity | 1 | 1.3 ft ² | 461.5 ft/min | 1/2 inch Nominal Sweat (5/8 O.D.) |
| Performance | | | | | |
| Total Capacity Btu/hr | Air Dry Bulb | | Temperature | | |
| | Entering °F | Leaving °F | Entering °F | Fluid Leaving °F | |
| 20641 | 70.0 | 101.5 | 180.0 | 160.2 | |
| Fluid | | | | | |
| Type | Flow Rate gpm | | Pressure Drop ft H ₂ O | | Unit Handling |
| Water | 2.1 | | 11.81 | | Left Hand (Front of Face) |

| Hot Water Preheat Coil | | | | | |
|------------------------|--------------------------|---------------|-----------------------------------|------------------|-----------------------------------|
| Physical | | | | | |
| Fins per Inch | Number of Rows | Coil Circuits | Face Area | Face Velocity | Connections |
| 12 | 1 row, Standard Capacity | 1 | 1.3 ft ² | 461.5 ft/min | 1/2 inch Nominal Sweat (5/8 O.D.) |
| Performance | | | | | |
| Total Capacity Btu/hr | Air Dry Bulb | | Temperature | | |
| | Entering °F | Leaving °F | Entering °F | Fluid Leaving °F | |
| 9512 | 70.0 | 84.5 | 120.0 | 110.9 | |
| Fluid | | | | | |
| Type | Flow Rate gpm | | Pressure Drop ft H ₂ O | | Unit Handling |
| Water | 2.1 | | 11.56 | | Left Hand (Front of Face) |

46% of original capacity

Limitations of existing heating equipment

The existing boilers can't sustain with low temp HW

- and -

The existing terminal equipment can't cover load with lower temp HW



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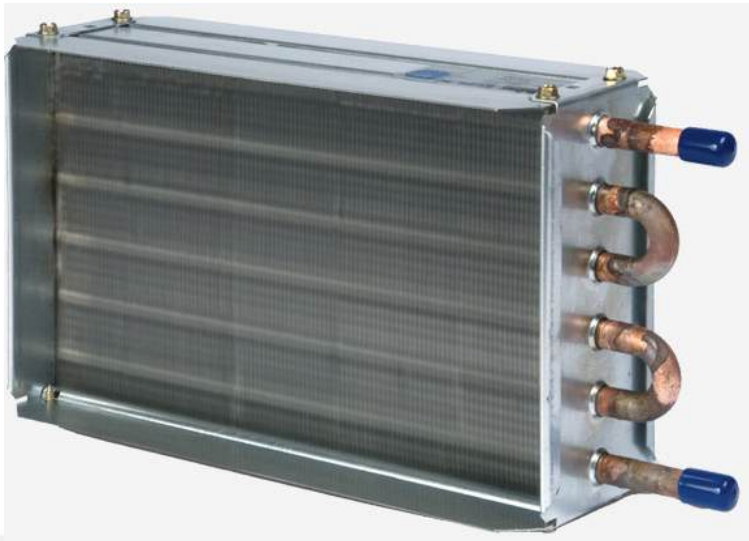
Making the Transition

- 1. Replace terminal equipment with equipment rated for lower temp HW**
 - » Remove the *need* for 180F HW
- 2. Replace non-condensing boilers with condensing boilers**
 - » Provide proper venting for condensing boilers
- 3. Add heat pumps**
- 4. Integrate proper control strategy**



Transitioning in Stages

AHU Coils – Added Rows



| Performance | | | | | | |
|--------------------------------------|--------------------|---------------------------|------------------------------|-------------------------|---|--|
| Air Flow CFM | Altitude ft | | Face Area ft ² | Face Velocity ft/min | | |
| 7500 | 0 | | 15.0 | 500.0 | | |
| Total Capacity Btu/hr | Temperature | | | | Air Pressure Drop inH ₂ O | |
| | Entering | | Air Dry Bulb °F | Leaving | | |
| | Air Dry Bulb °F | Water °F | | Water °F | | |
| 330236 | 45.0 | 180.0 | 85.3 | 160.0 | 0.12 | |
| Pressure Drop ft H ₂ O | Flow rate gpm | Fluid Velocity ft/s | | Type | Volume gal | |
| 13.8 | 32.8 | 5.8 | | Water | 3.00 | |

| Performance | | | | | | |
|--------------------------------------|--------------------|---------------------------|------------------------------|-------------------------|---|--|
| Air Flow CFM | Altitude ft | | Face Area ft ² | Face Velocity ft/min | | |
| 7500 | 0 | | 15.0 | 500.0 | | |
| Total Capacity Btu/hr | Temperature | | | | Air Pressure Drop inH ₂ O | |
| | Entering | | Air Dry Bulb °F | Leaving | | |
| | Air Dry Bulb °F | Water °F | | Water °F | | |
| 330761 | 45.0 | 120.0 | 85.3 | 99.8 | 0.16 | |
| Pressure Drop ft H ₂ O | Flow rate gpm | Fluid Velocity ft/s | | Type | Volume gal | |
| 4.7 | 32.8 | 2.9 | | Water | 7.00 | |

Increase coil rows. Maintain similar air pressure drop and water pressure drop

Transitioning in Stages

Fan Coil Units – Added Rows



| Hot Water Preheat Coil | | | | | |
|--------------------------|--------------------------|--------------------------------------|---------------------------|---------------|-----------------------------------|
| Physical | | | | | |
| Fins per Inch | Number of Rows | Coil Circuits | Face Area | Face Velocity | Connections |
| 12 | 1 row, Standard Capacity | 1 | 1.3 ft ² | 461.5 ft/min | 1/2 inch Nominal Sweat (5/8 O.D.) |
| Performance | | | | | |
| Total Capacity Btu/hr | Temperature | | | | |
| | Air Dry Bulb | | Fluid | | |
| | Entering °F | Leaving °F | Entering °F | Leaving °F | |
| 20641 | 70.0 | 101.5 | 180.0 | 160.2 | |
| Fluid | | | | | |
| Type | Flow Rate gpm | Pressure Drop ft H ₂ O | Unit Handling | | |
| Water | 2.1 | 11.81 | Left Hand (Front of Face) | | |

| Hot Water Coil | | | | | |
|--------------------------|------------------|--------------------------------------|---------------------------|-----------------------------------|--|
| Physical | | | | | |
| Fins per Inch | Number of Rows | Coil Circuits | Face Area | Connections | |
| 12 | 3 | 4 | 2.1 ft ² | 1/2 inch Nominal Sweat (5/8 O.D.) | |
| Performance | | | | | |
| Total Capacity Btu/hr | Temperature | | | | |
| | Air | | Fluid | | |
| | Entering °F | Leaving °F | Entering °F | Leaving °F | |
| 23755 | 70.0 | 106.2 | 120.0 | 100.0 | |
| Fluid | | | | | |
| Type | Flow rate gpm | Pressure Drop ft H ₂ O | Unit Handling | | |
| Water | 2.4 | 1.72 | Left Hand (Front of Face) | | |

Transitioning in Stages

Multi-pass low-temp fin tube (with fan assist)



BTU/ft at 65F EAT

| Height (in) | Rows | C/C (in) | Steam (1 psi 215°F) | Average Water Temperature (°F) | | | | | | | |
|-------------|------|----------|---------------------|--------------------------------|------|------|------|------|------|-----|-----|
| | | | | 210 | 200 | 190 | 180 | 170 | 160 | 150 | 140 |
| 12 | 1 | - | 1964 | 1866 | 1689 | 1532 | 1355 | 1198 | 1041 | 884 | 786 |



| Passes | Height/Depth | Width | 120/100/65° |
|--------|--------------|-----------|----------------|
| # | H in inch | D in inch | BTU/h per foot |
| 8 | 14 | 8.6 | 840 |

w/out fan assist

| Passes | Height/Depth | Width | 120/100/65° |
|--------|--------------|-----------|-------------|
| # | H in inch | D in inch | BTU/h per |
| 8 | 14 | 8.6 | 1273 |

w/ fan assist

Making the Transition

Replace non-condensing Boilers with *Condensing* Boilers

- › Opportunity to right-size?
 - » Has the building been tested for how much boiler capacity is actually used?
 - » Are there logs of boiler capacity over time?
- › Replace existing chimney / draft venting systems with proper venting systems designed for condensing boilers, inclusive of condensate management
- › Optimize boiler operation strategy to maximize efficiency. Often available from boiler manufacturer controls.

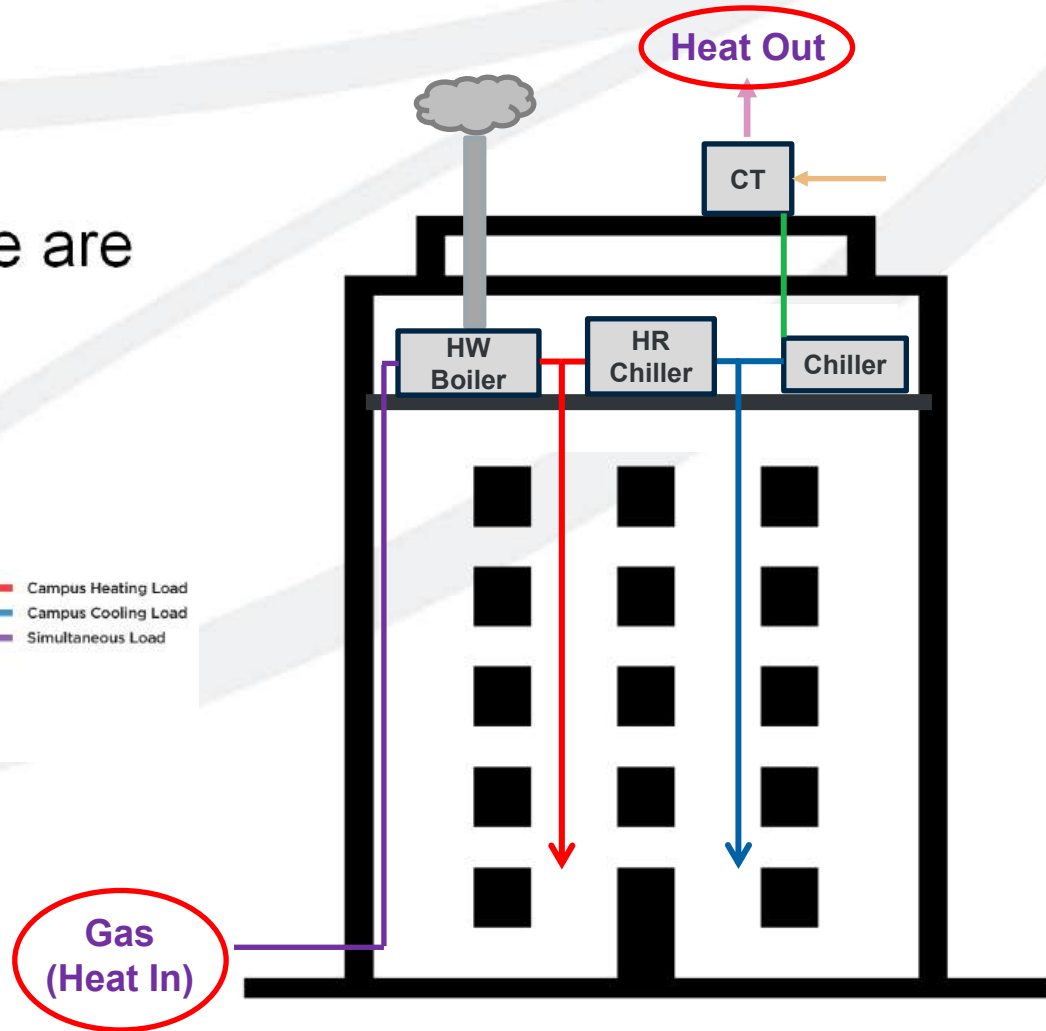
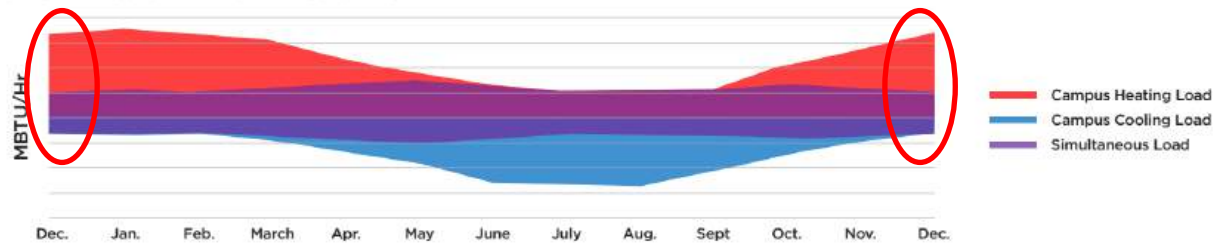


Making the Transition

Heat recovery on 4-pipe systems

- › Energy savings on shoulder days
- › Reduced peak heating load if there are year-round cooling loads

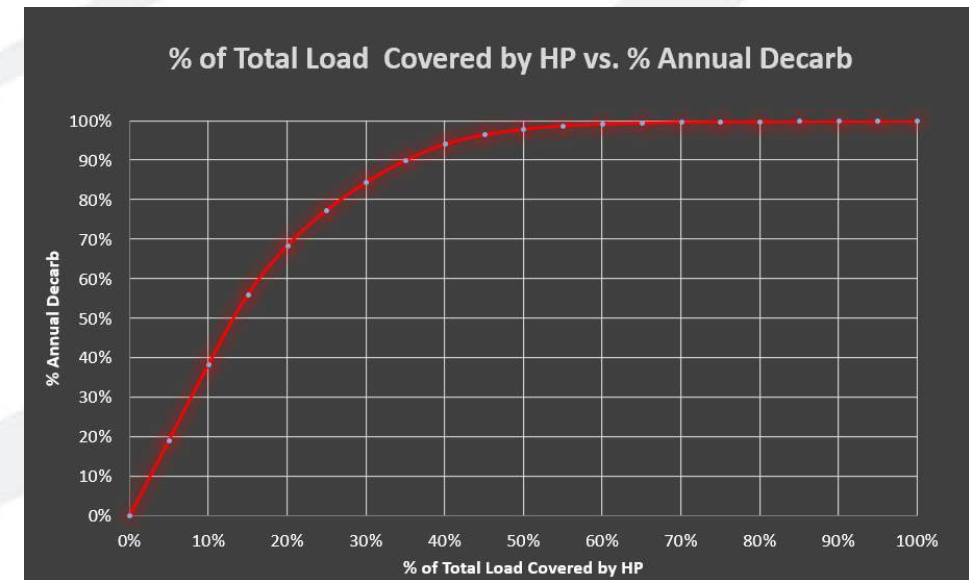
SIMULTANEOUS HEATING AND COOLING



Making the Transition

Add heat pumps

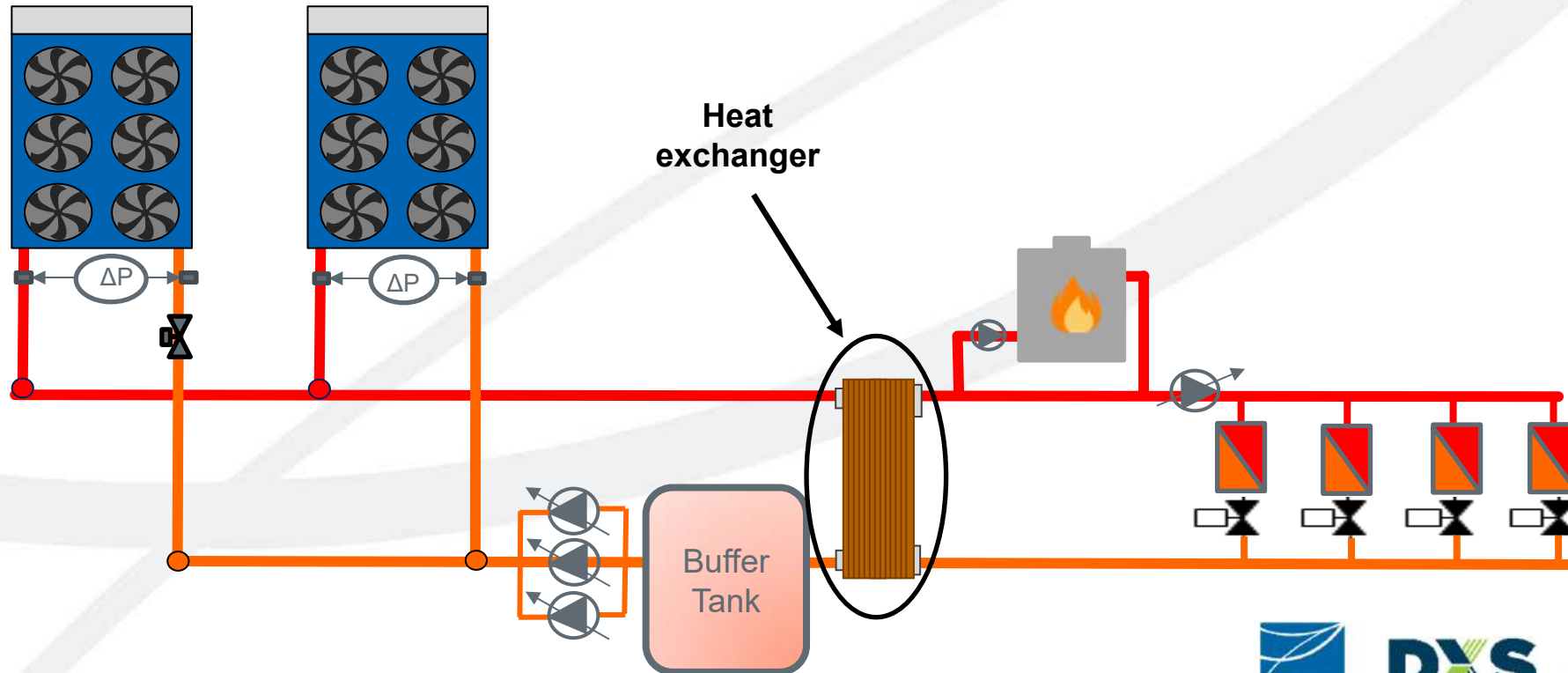
- › Find the right value for heat pump capacity vs. boiler offset
- › What's the goal?
 - » Minimum carbon impact? Lowest annual operating cost?
These two might result in different strategies



Making the Transition

Add heat pumps

- › Requires additional pumps and heat exchangers due to glycol in air-to-water heat pumps

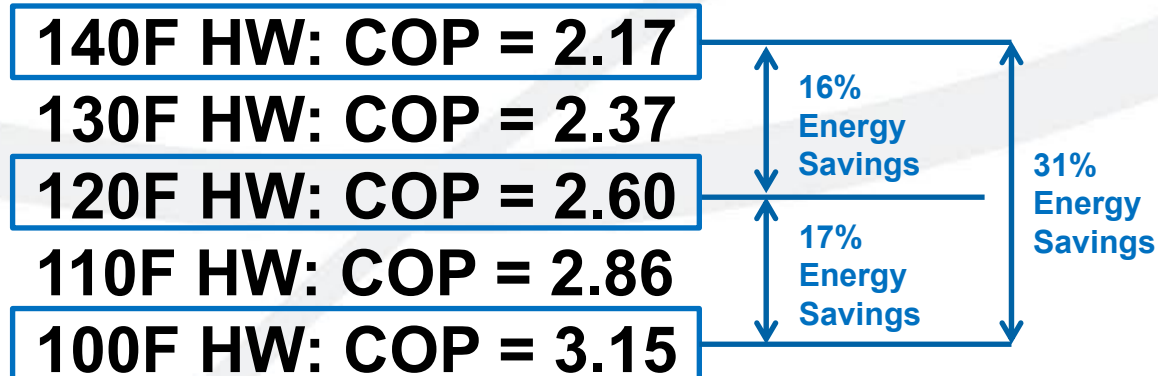


Making the Transition

Integrate proper control strategy

- › Find efficiencies for hybrid heating plant
 - » Variable ambient lockout temp based on utility costs
 - » HW temp reset for efficiency increase
 - » Plant optimization (mindful of pump energy)

At 40F ambient



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Low-Temperature Hydronic Heating Applications

Jaga is a Belgian manufacturer that specializes in hydronic heating and cooling solutions with a specific focus on the use of low-temperature hot water heating (and higher temperature chilled water cooling).



jaga
CLIMATE
DESIGNERS



Improved Finned Tube Element

- Ideal for hydronic systems operating at 120°F or below
- Corrugated (enhanced) fins
- Can be used with or without fan assist
- Tubes are engineered to maintain turbulent flow as low as 0.15 GPM, giving application flexibility
- Proprietary anti-static coating for sustained performance



Finned Tube – Fan Assist v.s. No Fan

Without Fan Assist

| Group | Model | Height/Depth | Length | Type | Width | 120/100/65° | | | Water side pressure drop ftH2O |
|-----------------|-----------------|--------------|-----------|------|-----------|------------------|----------------|-------------|--------------------------------|
| | | H in inch | L in inch | | D in inch | Heating in BTU/h | BTU/h per foot | Flow in GPM | |
| Horizontal Wall | Strada Continuo | 14 | 23.5 | 10 | 4.8 | 797 | 405 | 0.08 | 0.0006 |

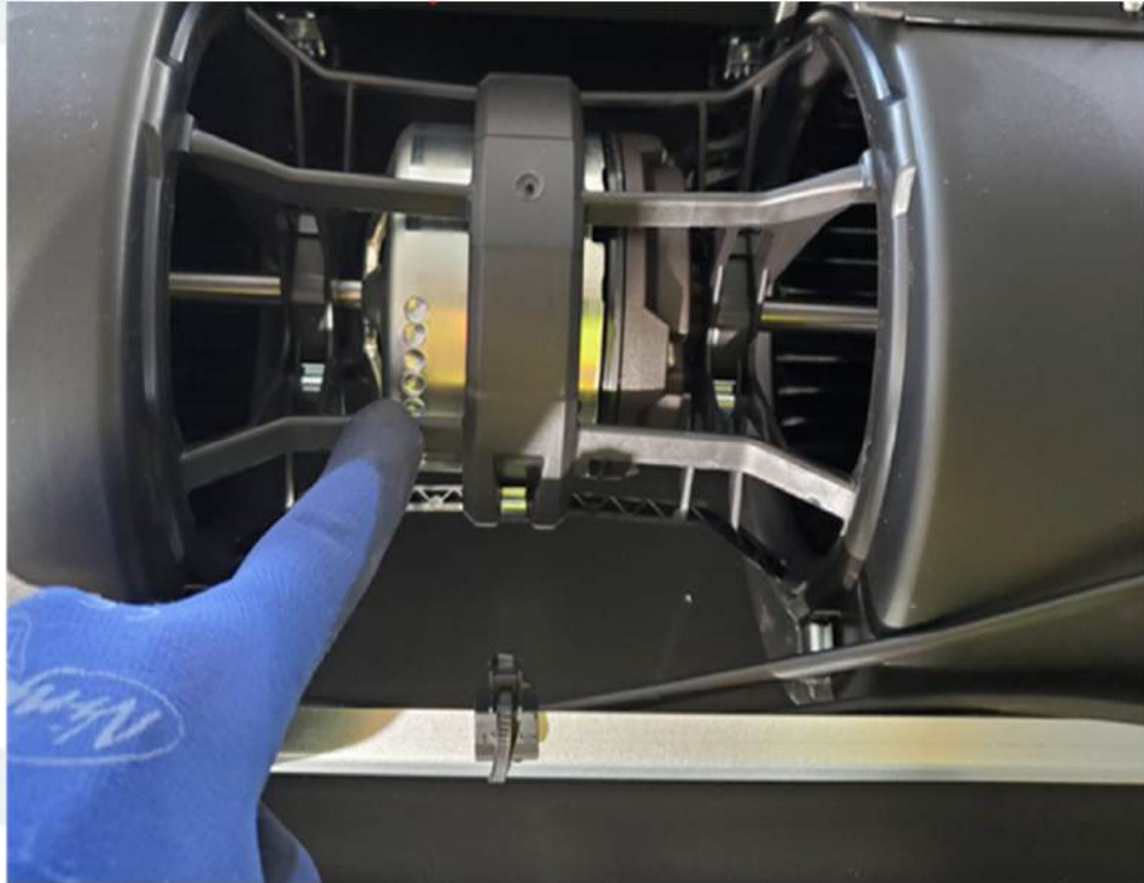
With Fan Assist

| Group | Model | Height/Depth | Length | Type | Width | 120/100/65° | | | Water side pressure drop ftH2O |
|-----------------|-----------------|--------------|-----------|------|-----------|------------------|----------------|-------------|--------------------------------|
| | | H in inch | L in inch | | D in inch | Heating in BTU/h | BTU/h per foot | Flow in GPM | |
| Horizontal Wall | Strada Continuo | 14 | 23.5 | 10 | 4.8 | 1155 | 590 | 0.12 | 0.0008 |

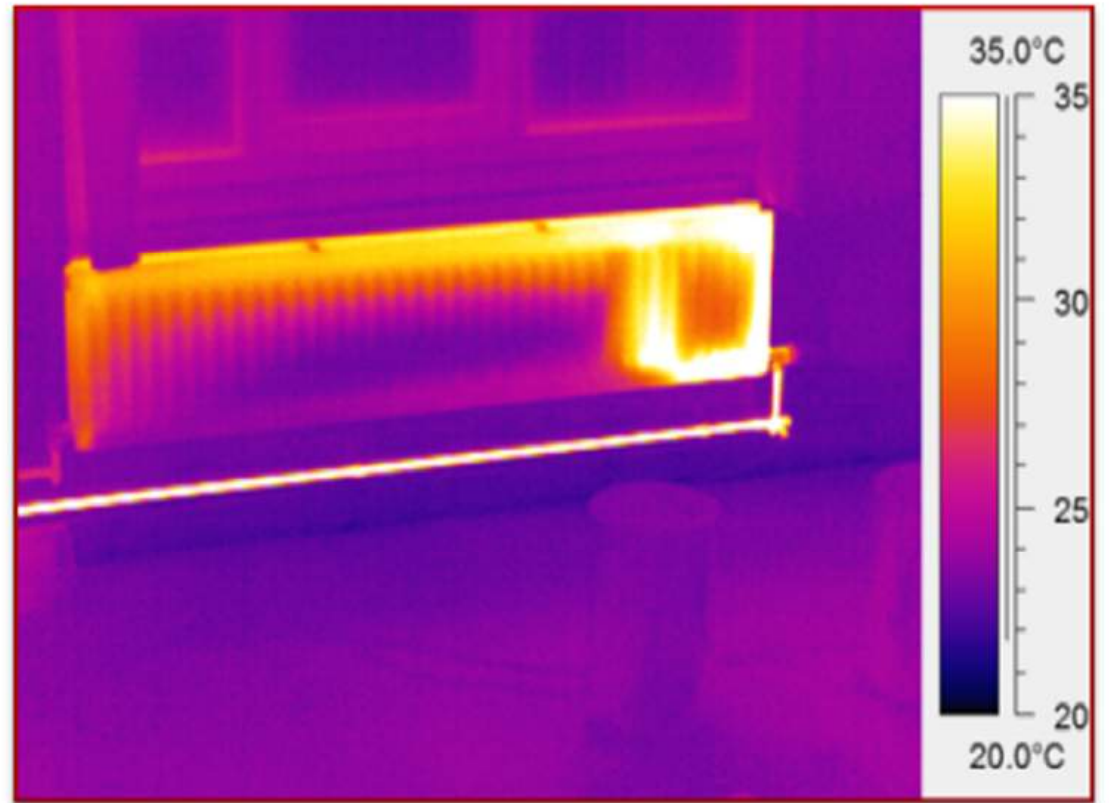
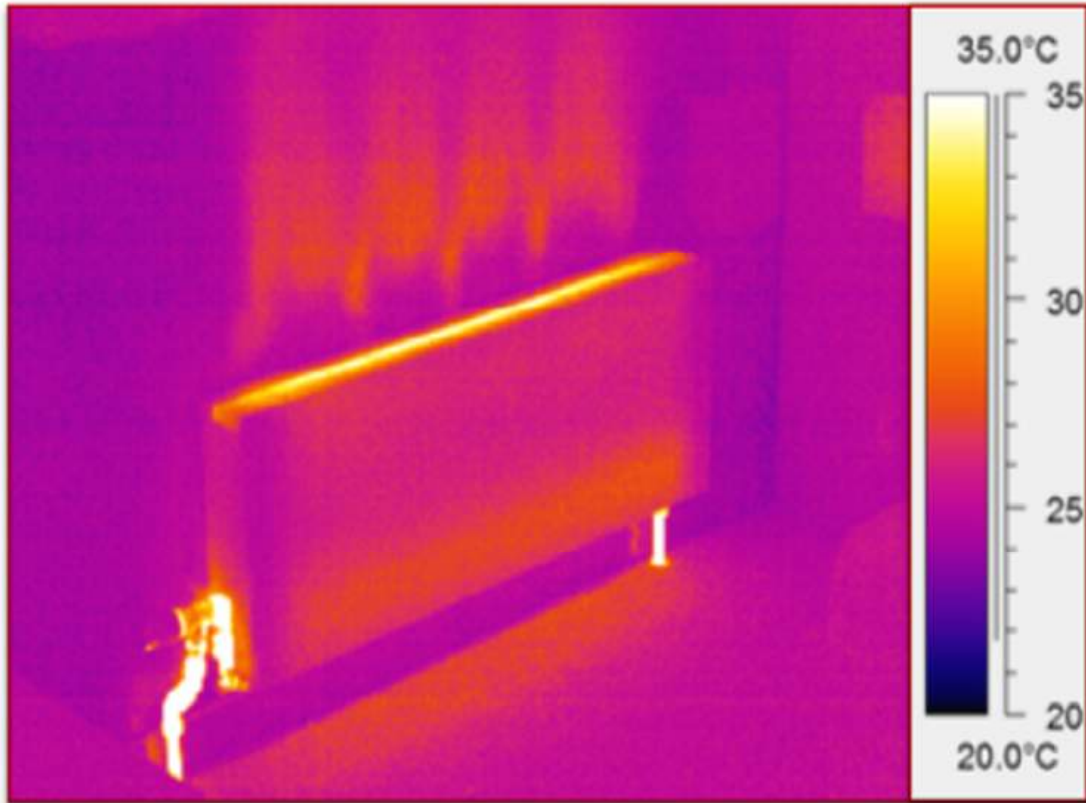
Approximate Increase of 45%



Deeper Look into Fan Assist



Multi-Pass Convectors vs. Legacy Radiators

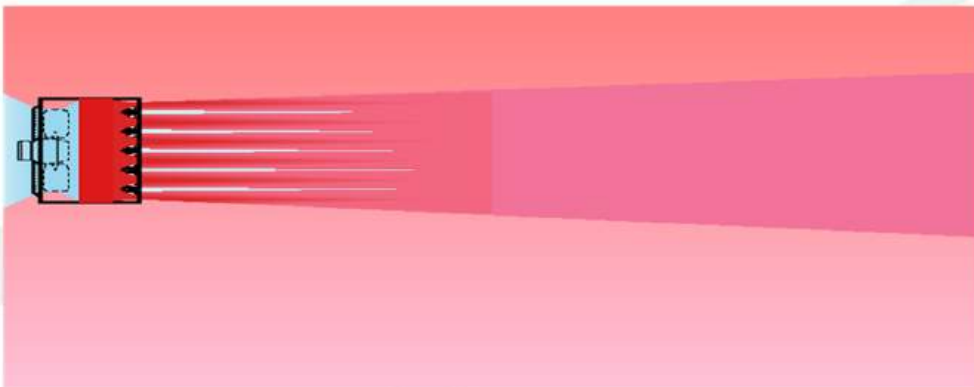


Unit Heater – Venturi Effect

TRADITIONAL UNIT HEATERS



JAGA UNIT HEATER WITH AVS



Briza Fan Coil Unit

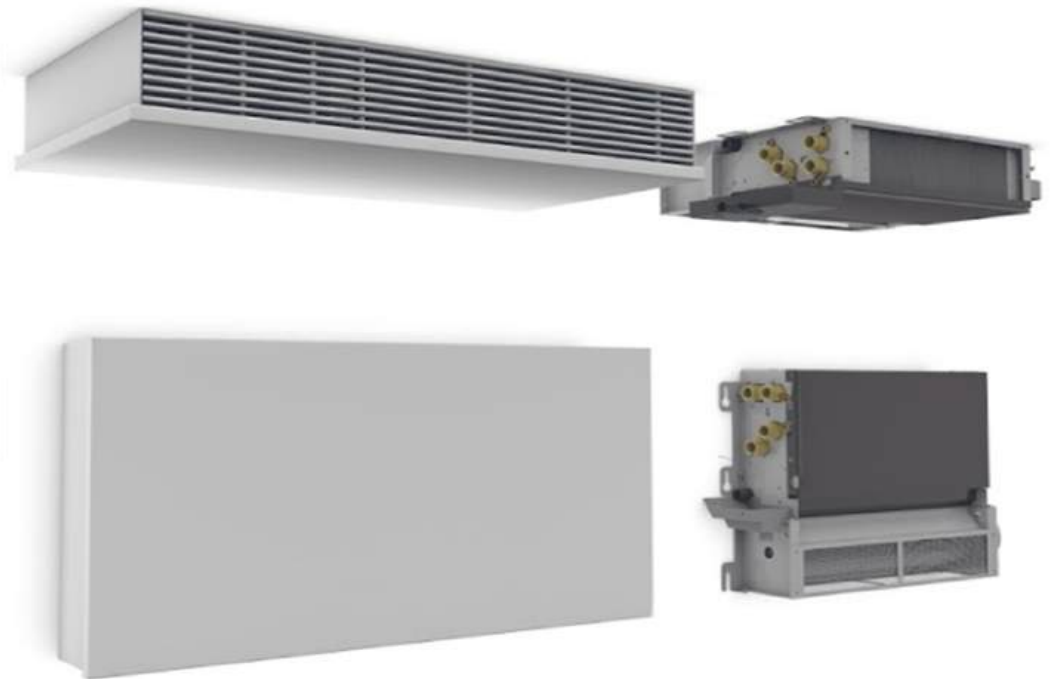
Low Voltage, Ultra Thin FCU

Depth 4 ½" – 6 ¾"



Traditional line voltage, compact FCU

Depth 8 ¾" – 10 "



Terminal Heating Types

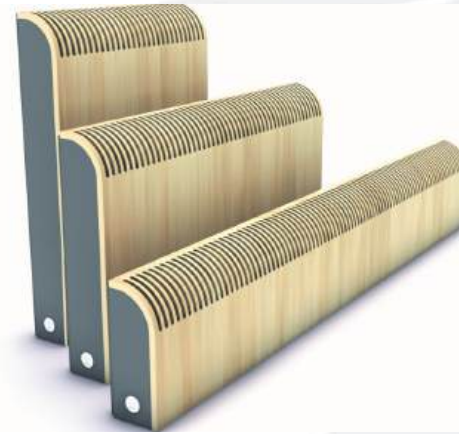
Continuo



Free-Standing



Knock-On-Wood



Clima Canal



Tempo



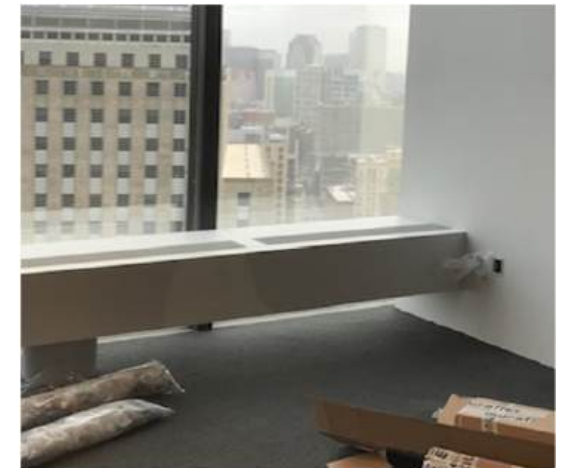
Vertiga



Build-in-Wall



Induction



What we discussed today

- **Decarbonizing and reducing energy in existing buildings requires the use of lower temperature hot water**
- **Integration of new equipment is required to do this**
- **There are steps that can be followed to do this**
 - Remove the *need* for 180F hot water
 - Provide central equipment can efficiently provide low-temp HW
 - Create the proper control strategy to optimize performance and operating cost
- **Heating products exist to facilitate this transition**



Thank you



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