TRI-COUNTY
REGIONAL ENERGY NETWORK
SAN LUIS OBISPO • SANTA BARBARA • VENTURA

Understanding Heat Pump HVAC and Water Heating

Russ King – Coded Energy

December 16, 2025

Before We Begin

Here are some quick reminders:

- Call in? Please **share** full name to confirm attendance
- To receive AIA LUs, you **must attend** at least 80% of the training. Attendance will be verified
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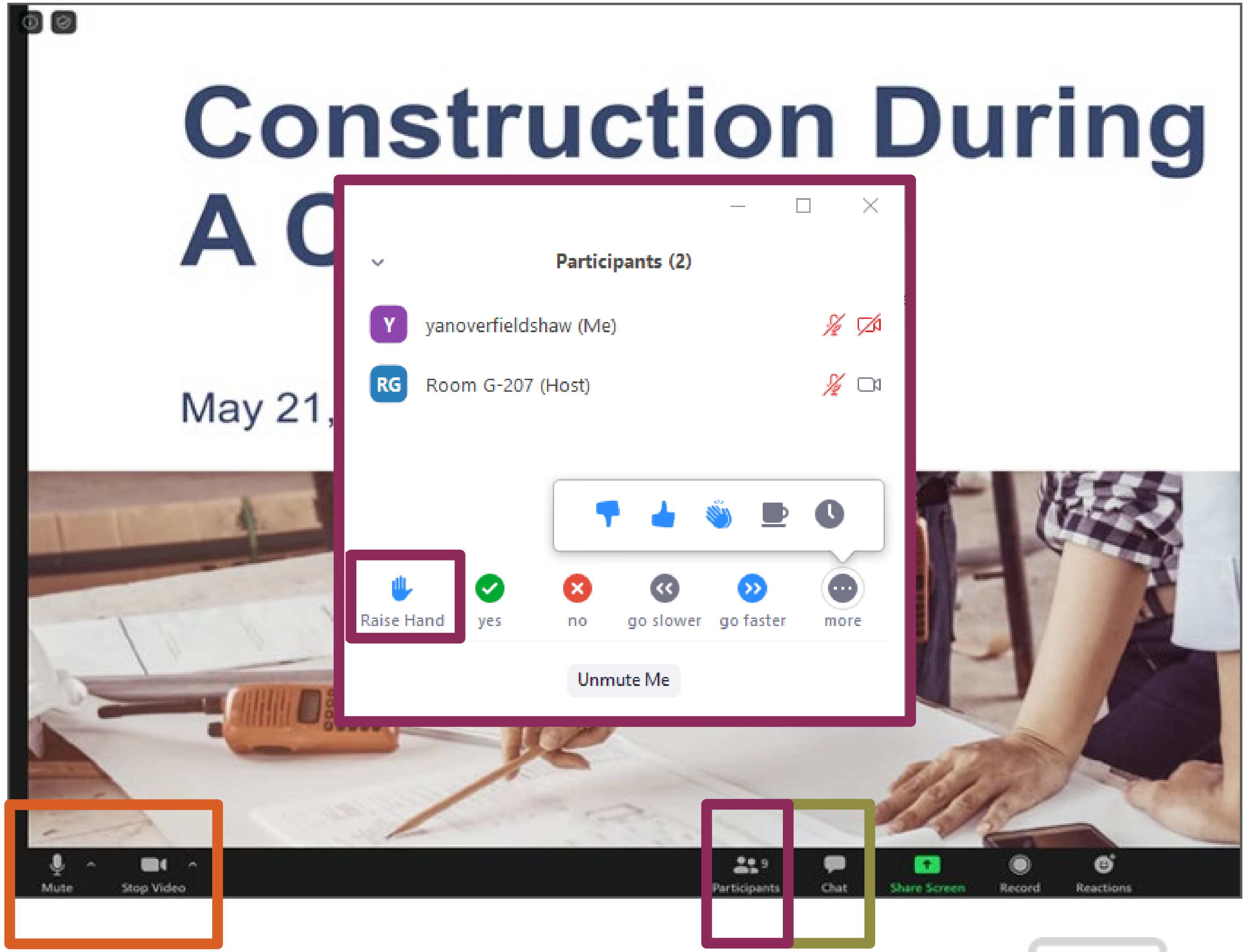

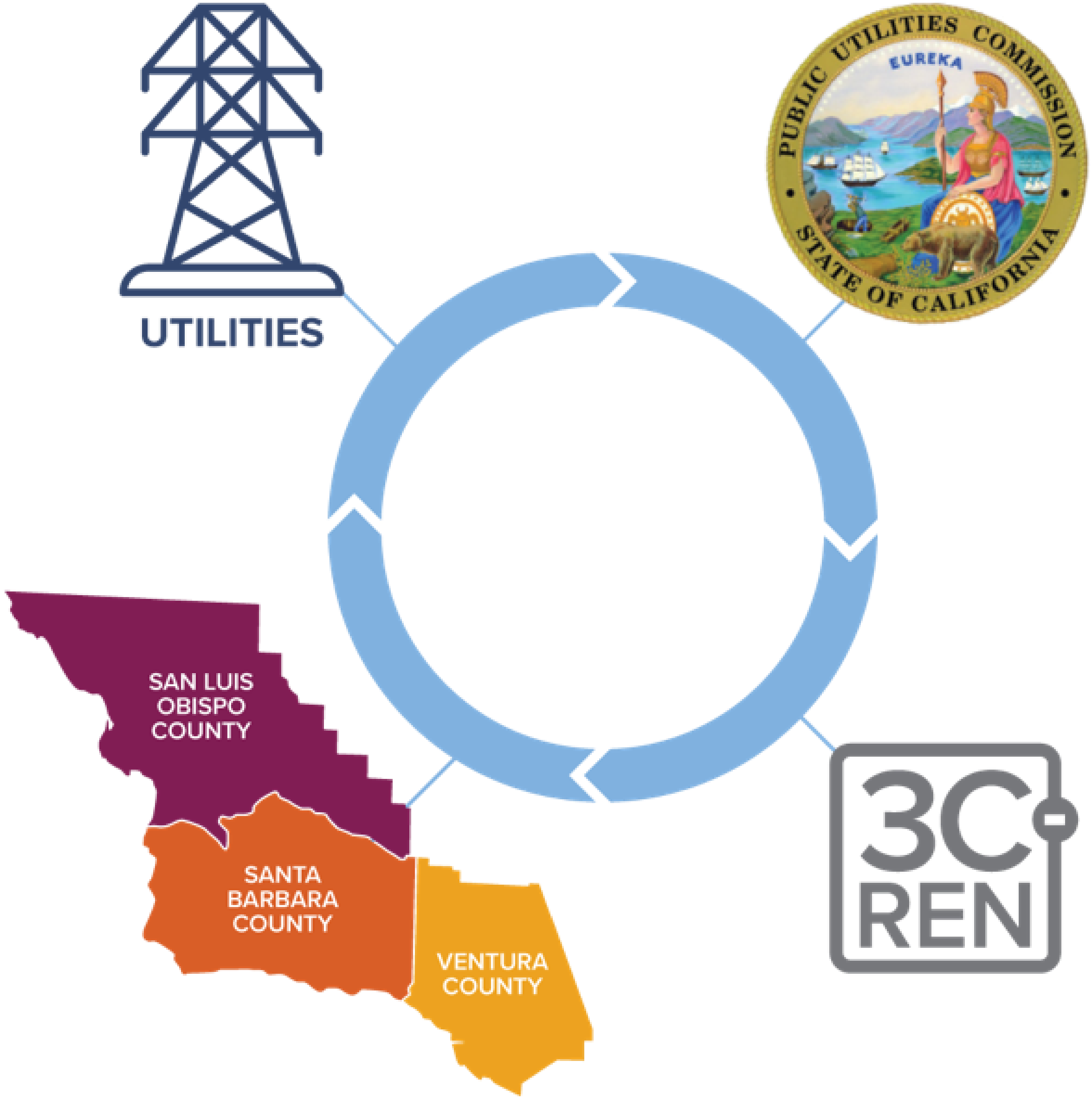

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Our programs reduce energy use for a more sustainable, equitable and economically vibrant Central Coast

Our free services are funded via the CPUC, bringing ratepayer dollars back to the region

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HEAT PUMPS FOR RESIDENTIAL SPACE HEATING AND COOLING

UNDERSTANDING HEAT PUMPS FOR RESIDENTIAL HVAC AND WATER HEATING

Agenda for Today

1. Introduction
2. Terminology
3. Super Basic Thermodynamics and the Refrigeration Cycle
4. Advantages of Heat Pumps for Space Heating
5. Types of Heat Pumps for Space Heating
6. Sizing Heat Pumps
7. Heat Pumps for Water Heating

Present by:
Russell King, ME
Coded Energy, Inc.

CODED ENERGY

1. INTRODUCTION

I. INTRODUCTION

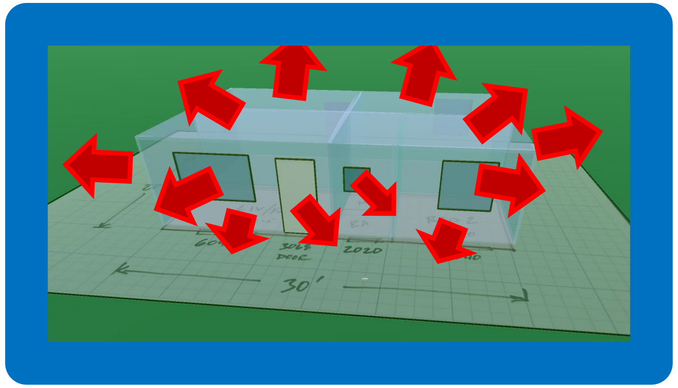
- Instructor – Russell King, M.E.
- Licensed Mechanical Engineer (3 states)
- CEO of Coded Energy, Inc. (Developers of Kwik Model 3D HVAC design software and DIYLoadCalcs.com)
- 35+ years experience with residential HVAC design and energy efficiency consulting and testing
- russ@coded.energy
- HVAC Blog: www.russellking.me
- Author of "*HVAC 1.0 – Introduction to Residential HVAC Systems*"

1. INTRODUCTION

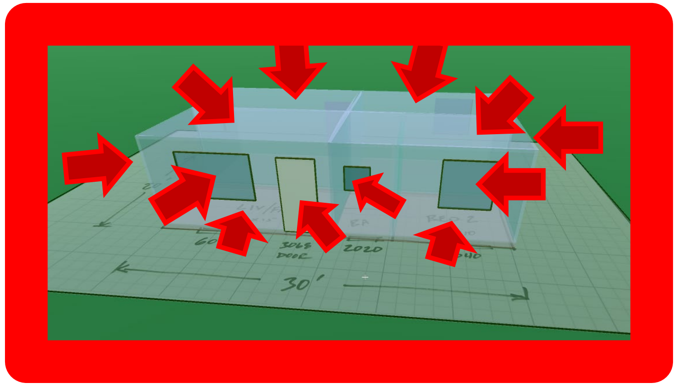
- To really appreciate heat pumps, you must first understand a little about the **how** and **why** we heat and cool our homes.
- Obviously, the main reason is for **comfort** and, in some extreme climates, for **health** and **safety**.
- Because the excessive use of energy also has many negative impacts, we want to do this as efficiently as possible.

1. INTRODUCTION

- HVAC = Heating Ventilation and Air Conditioning
- The main goal of an HVAC system is to maintain a constant temperature in a house.
- Houses lose heat in the winter and gain heat in the summer.
- To maintain a constant temperature in the winter the heater must replace BTUs that are lost.
- To maintain a constant temperature in the summer, the AC must remove BTUs that are gained.



Winter



Summer

2. TERMINOLOGY

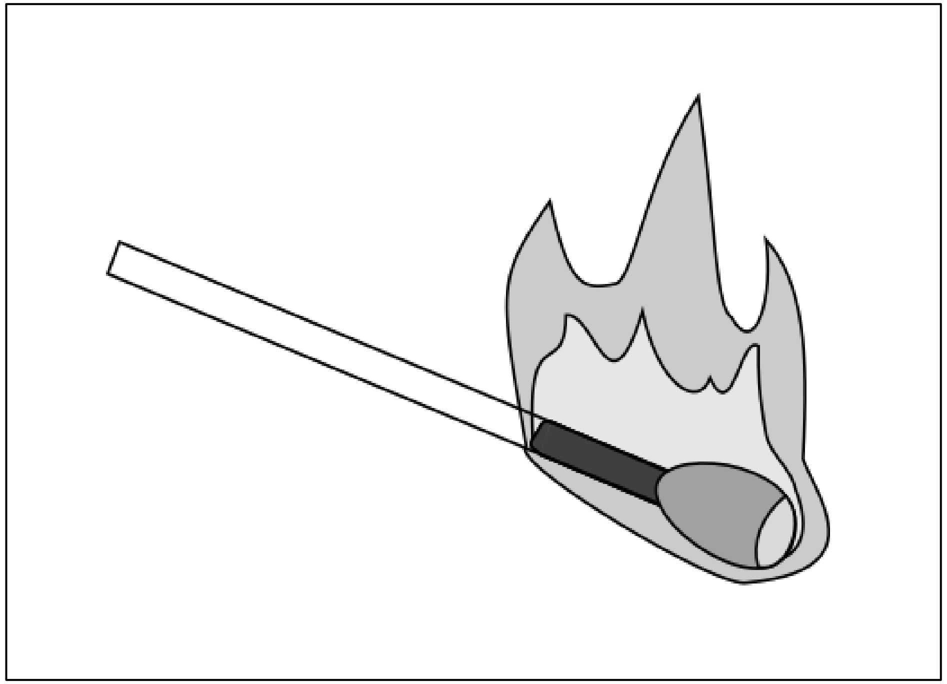
2. TERMINOLOGY

British Thermal Unit (BTU)

- This is a unit of heat energy that is approximately equal to the heat stored in a wooden kitchen match.
- Heat moves at different ***rates***. We express this in BTUs per hour (Btuh)

2. TERMINOLOGY

This symbol will represent BTUs in the following diagrams.



2. TERMINOLOGY

Why do air conditioners and heat pumps come in sizes called "Tons"?

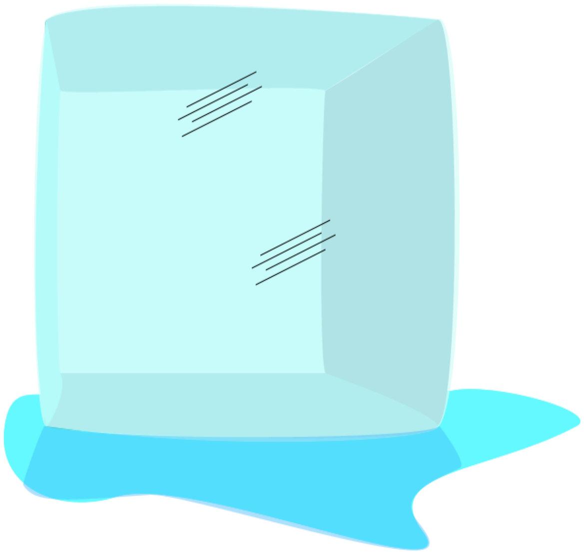
Before mechanical refrigeration we used to buy ice by the ton.

A ton of ice has a certain cooling capacity. About 12,000 BTUs per hr.

A 2-ton air conditioner, therefore, has a cooling capacity of about 2 x 12,000 = 24,000 BTU per hr.

This is called the nominal capacity.

The actual installed capacity depends on a lot of factors.

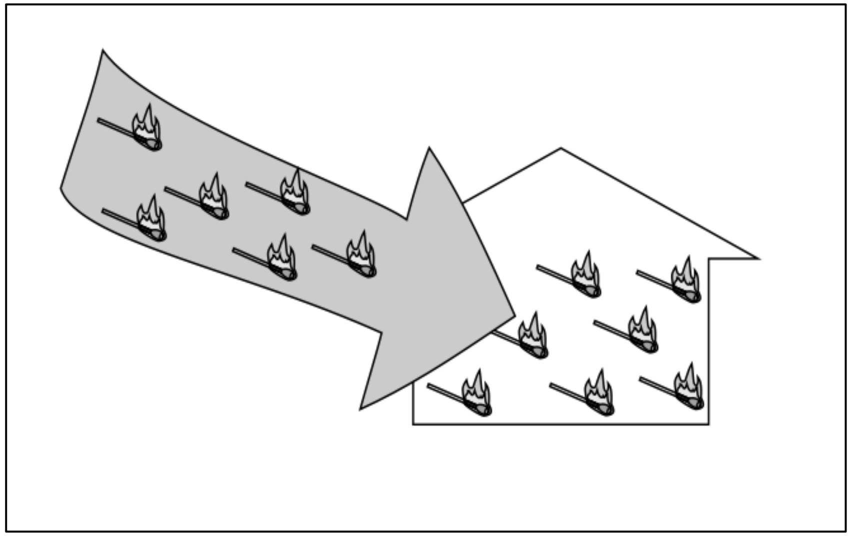


Images from *HVAC 1.0 – Introduction to Residential HVAC Systems*

2. TERMINOLOGY

Cooling Load

- In the summer, the BTUs are more concentrated outside the house than inside, so heat will naturally come into the house.
- The *cooling load* is the number of BTUs per hour that the air conditioner must remove at design conditions.
- This can be ***calculated*** for a home.



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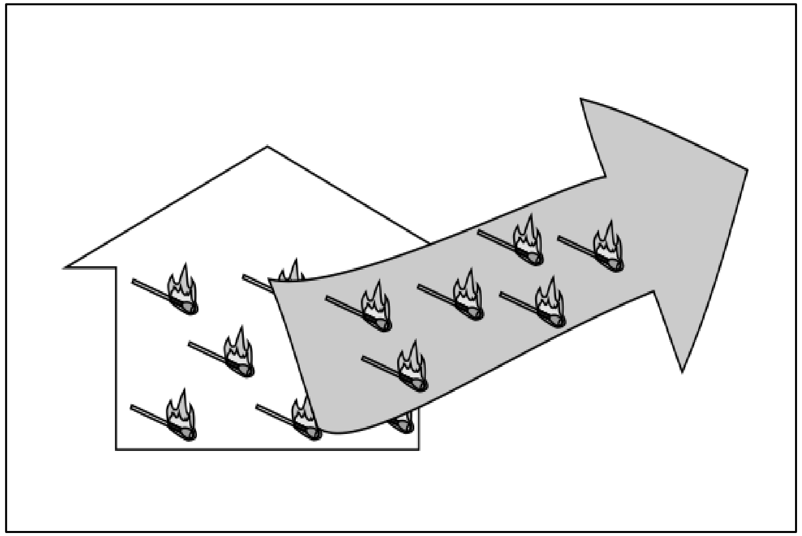
2. TERMINOLOGY

Cooling

Cooling is the process of removing heat from a house

- Consider an air conditioner that is tested to have a cooling capacity of 24,000 Btuh.
- This means that it can remove 24,000 kitchen matches worth of heat from the house in one hour.



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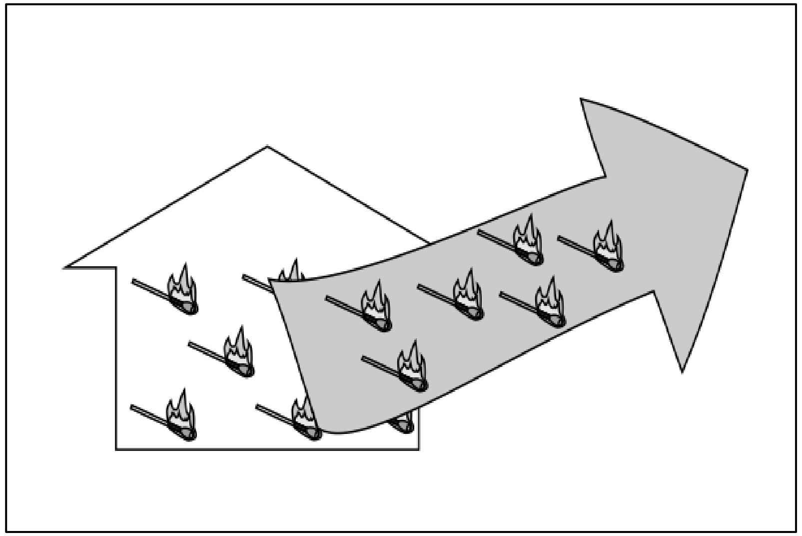
2. TERMINOLOGY

Heating Load

- In the winter the BTUs are more concentrated inside the house than outside, so heat will naturally leave the house.
- *Heating load* is the number of BTUs that the heater (heat pump or furnace) must *add* each hour at design conditions.
- This can be ***calculated*** for a home.



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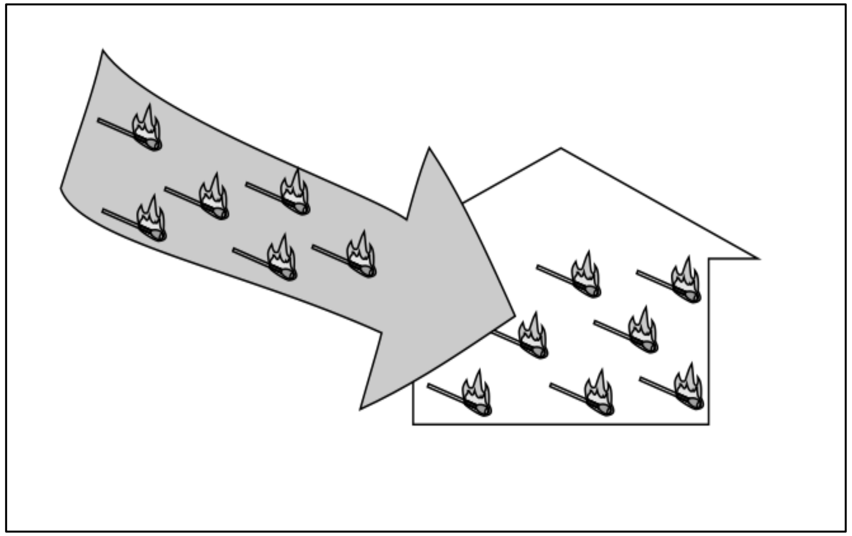
2. TERMINOLOGY

Heating

Heating is the process of adding BTUs to a house.

- Consider a heater that is tested to have a heating capacity of 30,000 btuh.
- This means that it can add 30,000 kitchen matches worth of heat to the house in one hour.



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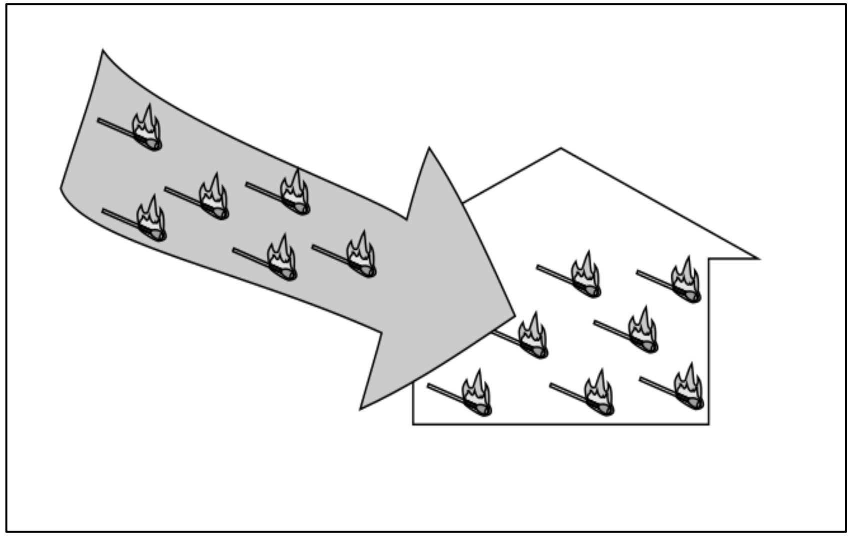
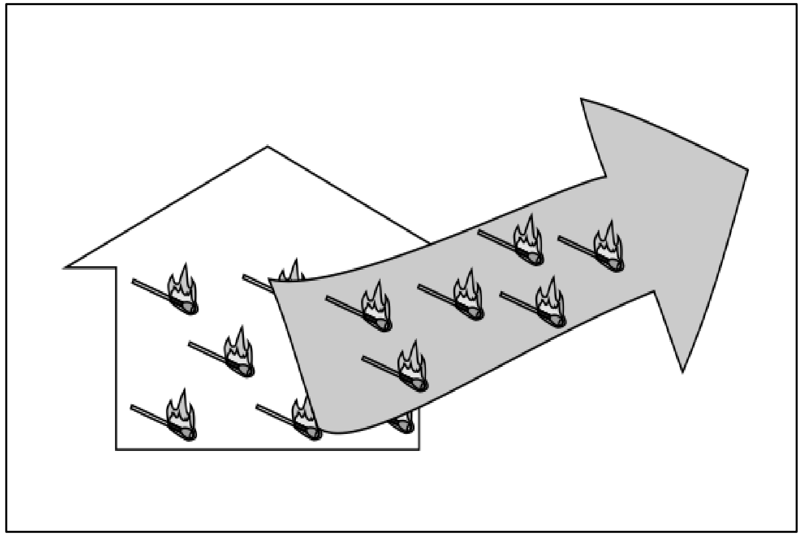
2. TERMINOLOGY

To maintain a **constant temperature** in a house the rate of heat coming in must **equal** the rate of heat going out.





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2. TERMINOLOGY

Capacity vs Load

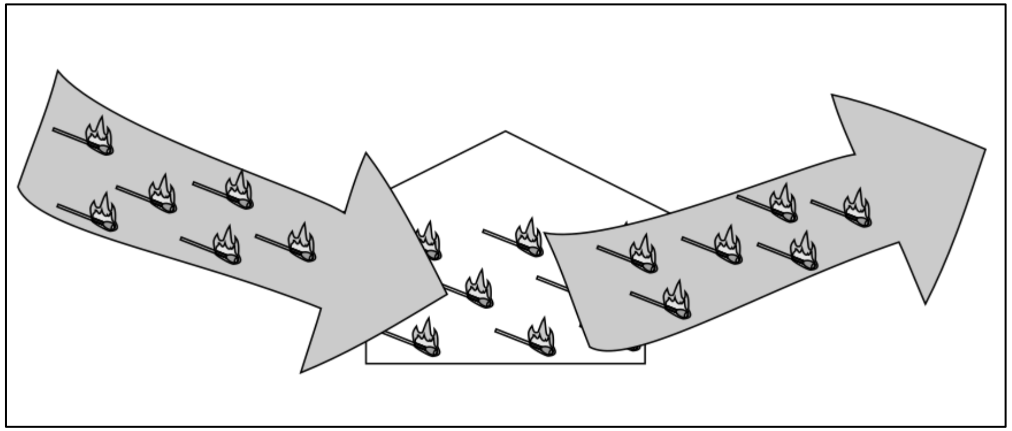
The **capacity** of the heating or cooling equipment is the *output* of the equipment in BTUs per hour. Think of it as the ***supply***.

The **load** of the house is what the house *needs* in BTUs per hour to maintain a constant temperature at design conditions. Think of it as the ***demand***.

2. TERMINOLOGY

Good equipment sizing is the ability to match the equipment's supply to the house's demand.

Not too big and not too small.



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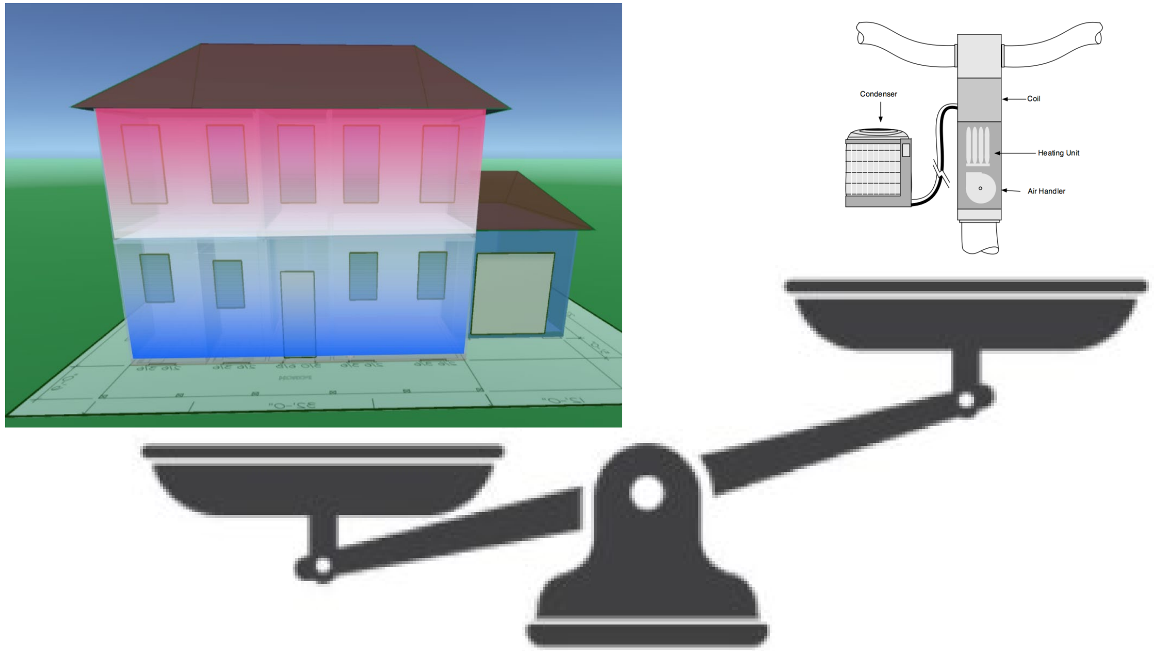
2. TERMINOLOGY

Undersizing is defined as when the *capacity* of the equipment is less than the *load* of the house.

The demand is greater than the supply and the equipment cannot keep up.



Load of House

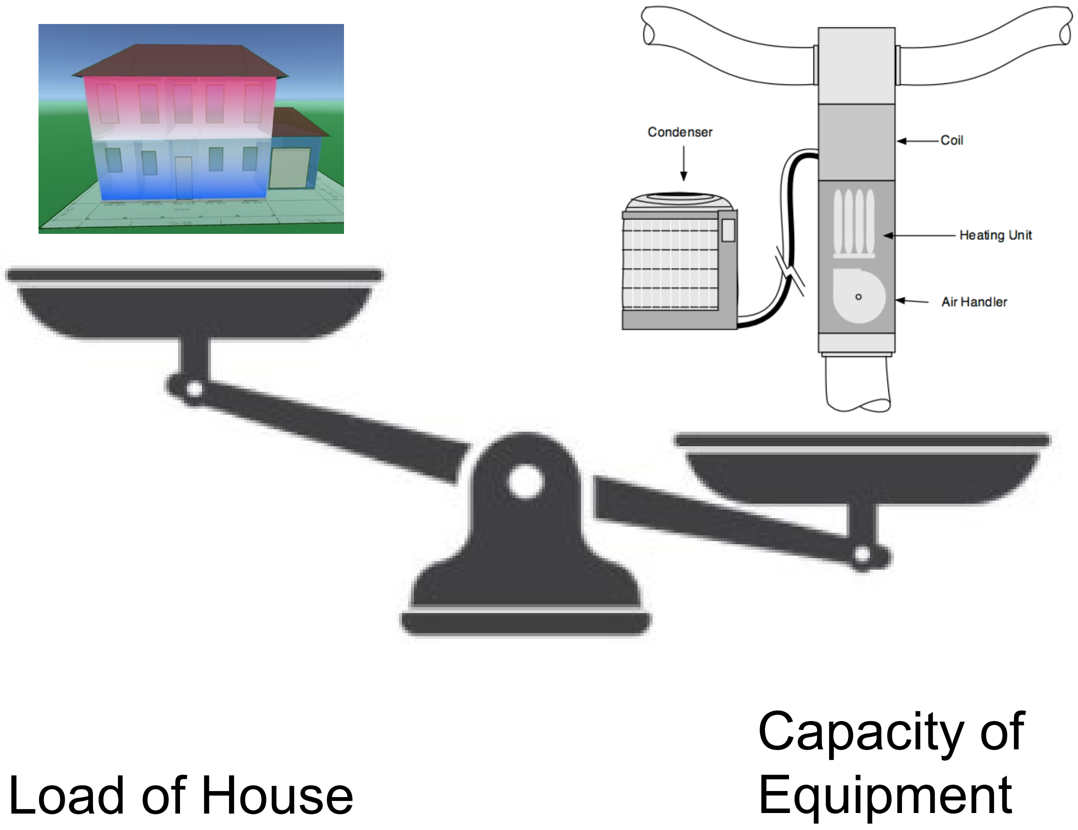
Capacity of Equipment

2. TERMINOLOGY

Oversizing is defined as when the *capacity* of the equipment is substantially higher than the *load* of the house.

The supply is much greater than the demand.

This can cause other issues.



2. TERMINOLOGY

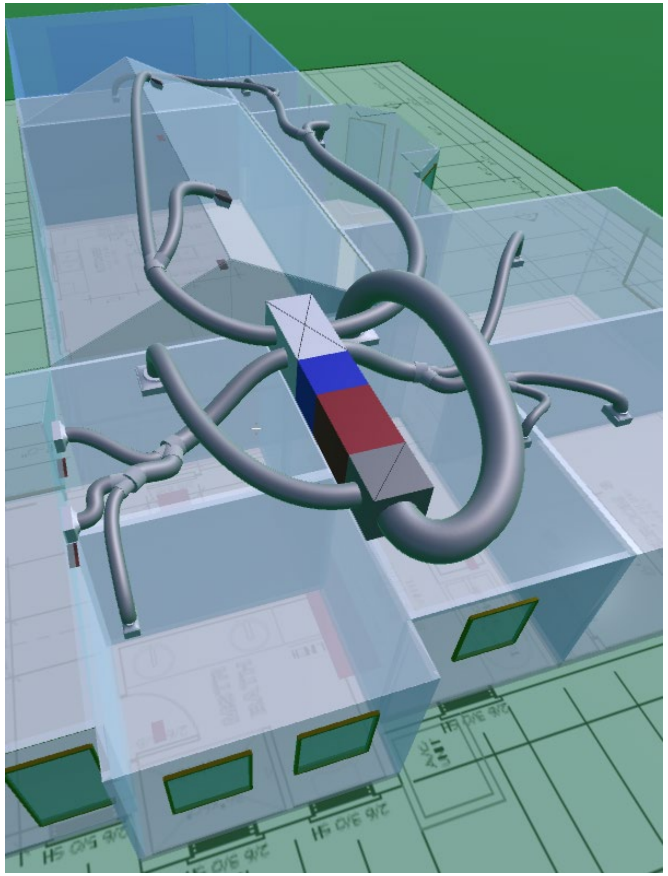
Design conditions are the code-specified indoor and outdoor temperatures at which the loads are calculated.

- These are not the *very worst* temperatures expected each summer or winter.

City	Latitude	Elevation (ft)	Longitude	Cooling 0.10% DB	Cooling 0.10% MCWB	Cooling 0.50% DB	Cooling 0.50% MCWB	Cooling 1.00% DB	Cooling 1.00% MCWB	Cooling 2.00% DB	Cooling 2.00% MCWB	Design Wetbulb 0.1%	Design Wetbulb 0.5%	Outdoor Daily Range	Heating Winter Median of Extremes	Heating Design Drybulb (0.2%)	Heating Design Drybulb (0.6%)	HDD*
Scotia	40.5	139	124.4	78	61	74	60	73	60	69	58	63	61	19	28	33	35	3954
Scotts Valley	37	400	122	94	68	88	66	86	66	81	64	69	67	28	27	32	35	1097
Seal Beach	33.8	21	118.1	94	69	86	68	84	67	80	65	71	69	15	35	40	42	1519
Seaside	36.6	17	122.9	85	66	79	64	77	64	73	62	67	65	20	30	35	37	
Sebastapol	38.4	102	122.8	99	69	96	68	95	68	92	66	71	69	35	24	27	29	1249
Selma	36.6	305	119.6	104	73	101	71	100	70	97	68	75	73	38	24	30	34	
Sepulveda	34.2	818	118.5	103	71	98	69	96	69	92	67	74	71	32	28	33	36	664

2. TERMINOLOGY

- The system needs to also work at milder conditions.
- If we design to really bad conditions, the equipment would be **oversized for most of the season.**
- **Oversizing will cause more comfort complaints than undersizing.**
- "Short cycling" of equipment can reduce comfort, shorten the life of equipment and increase energy use.

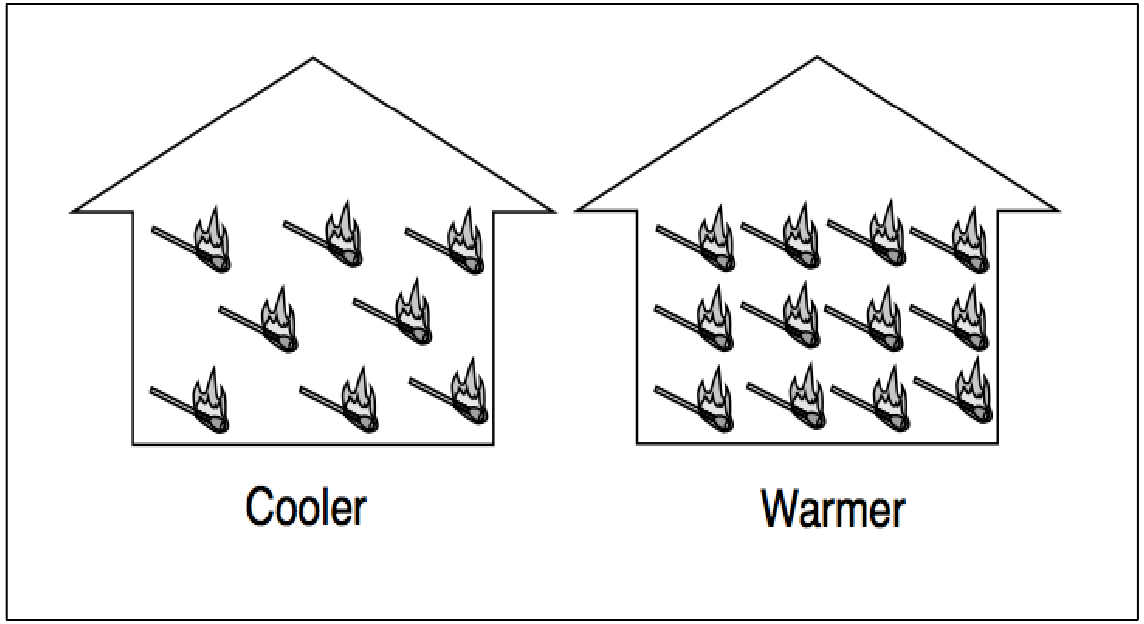


Screen snip from Kwik Model with EnergyGauge Loads

3. SUPER BASIC THERMODYNAMICS AND THE REFRIGERATION CYCLE

3. SUPER BASIC THERMODYNAMICS AND THE REFRIGERATION CYCLE

- Temperature = density of BTU's = how many BTU's you have in an object or volume of fluid
- Everything has ***some*** BTU's in it, even very cold air.



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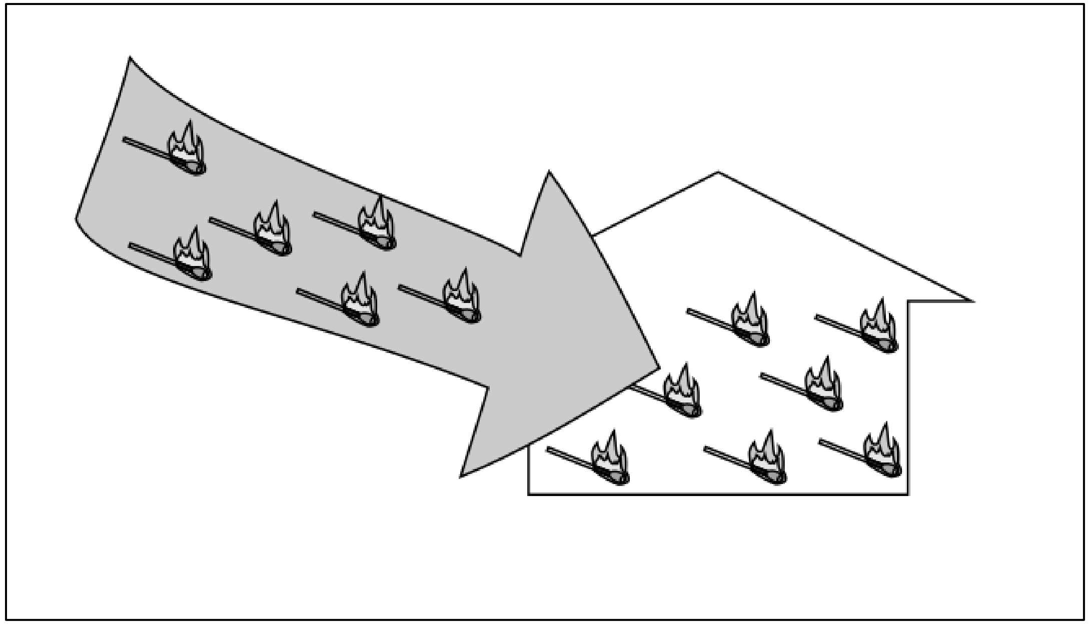
3. SUPER BASIC THERMODYNAMICS AND THE REFRIGERATION CYCLE

- Heating = BTU/hr = "kitchen matches **added** per hour"
- When you add BTU's to something the temperature goes up.



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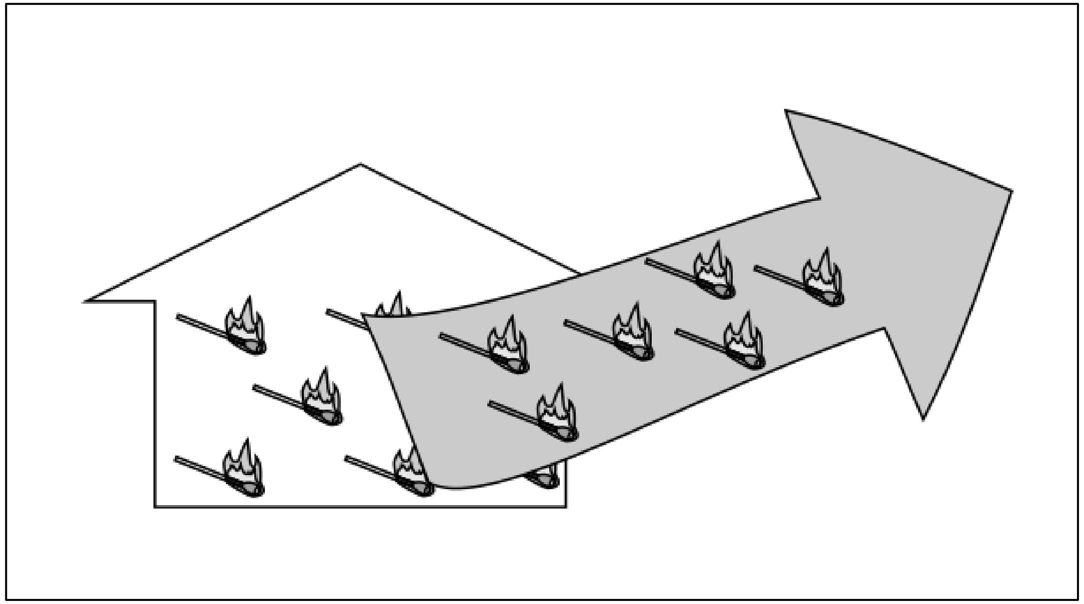
3. SUPER BASIC THERMODYNAMICS AND THE REFRIGERATION CYCLE

- Cooling = - BTU/hr = "kitchen matches **removed** per hour"
- When you remove BTU's from something the temperature goes down.



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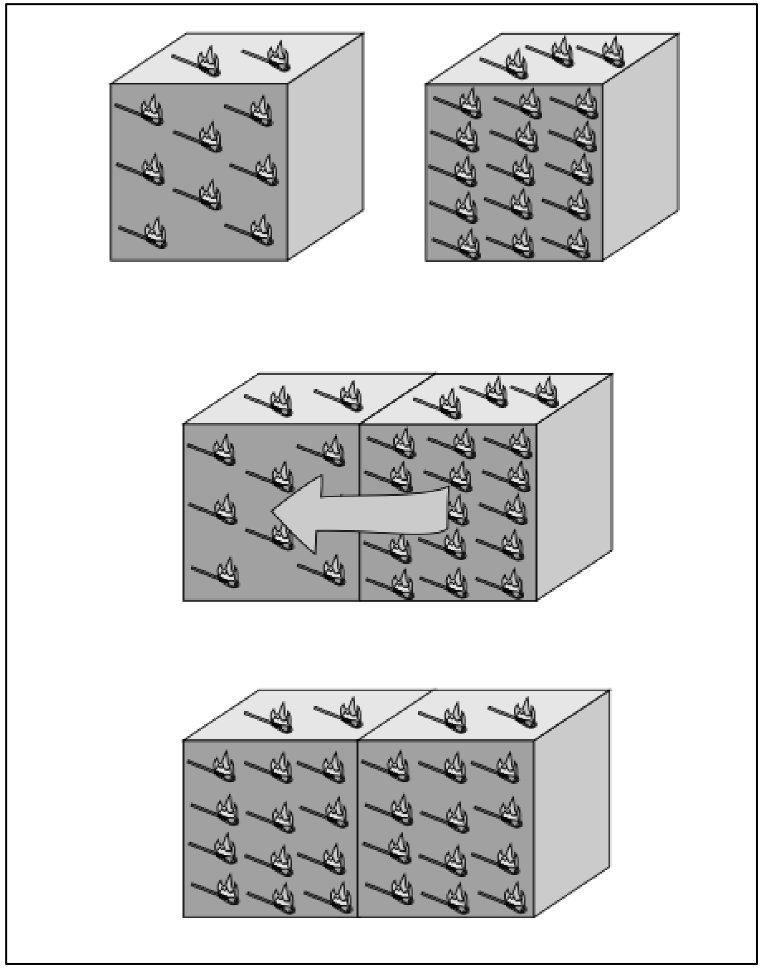
3. SUPER BASIC THERMODYNAMICS AND THE REFRIGERATION CYCLE

- BTU's naturally move from higher temperatures to lower temperatures, until the temperatures equalize.
- Aka, "Second Law of Thermodynamics"



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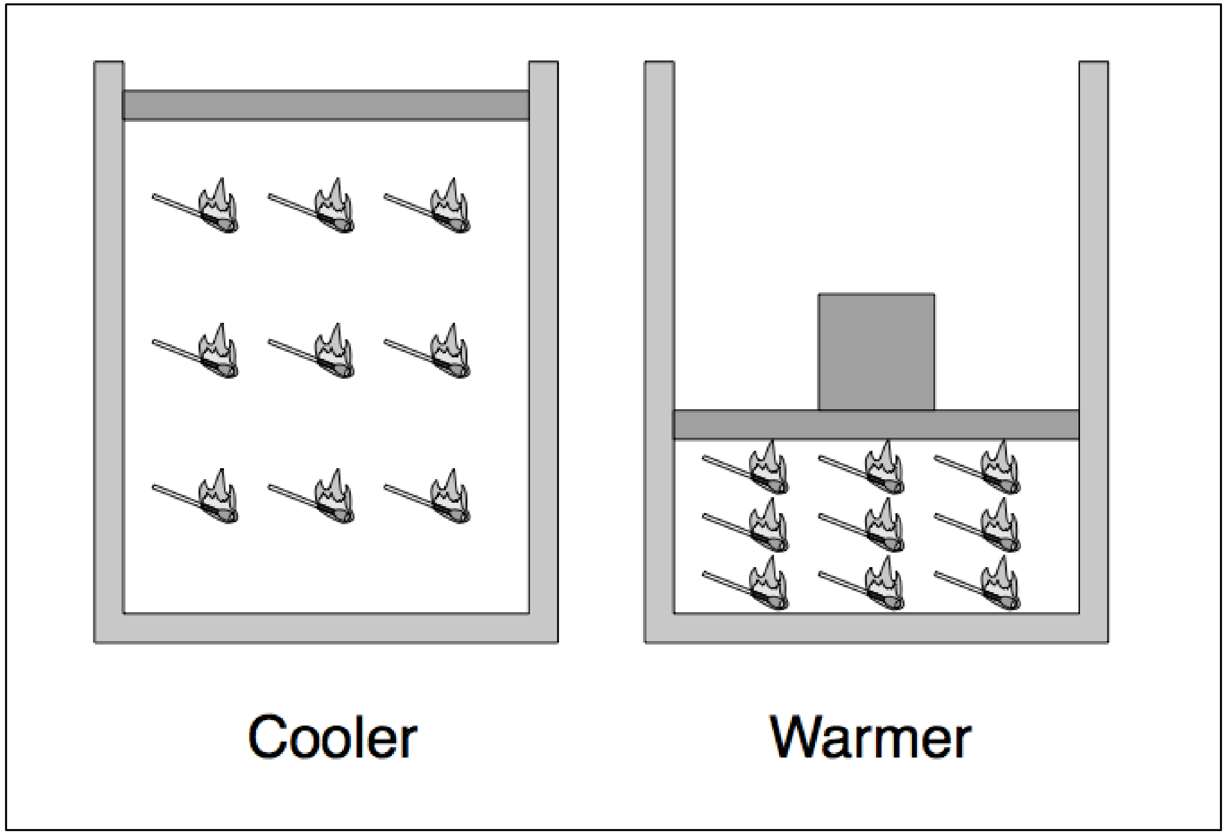
3. SUPER BASIC THERMODYNAMICS AND THE REFRIGERATION CYCLE

- If you **decrease** the volume of something that contains a certain number of BTU's, such as air, the temperature goes up, and visa-versa.



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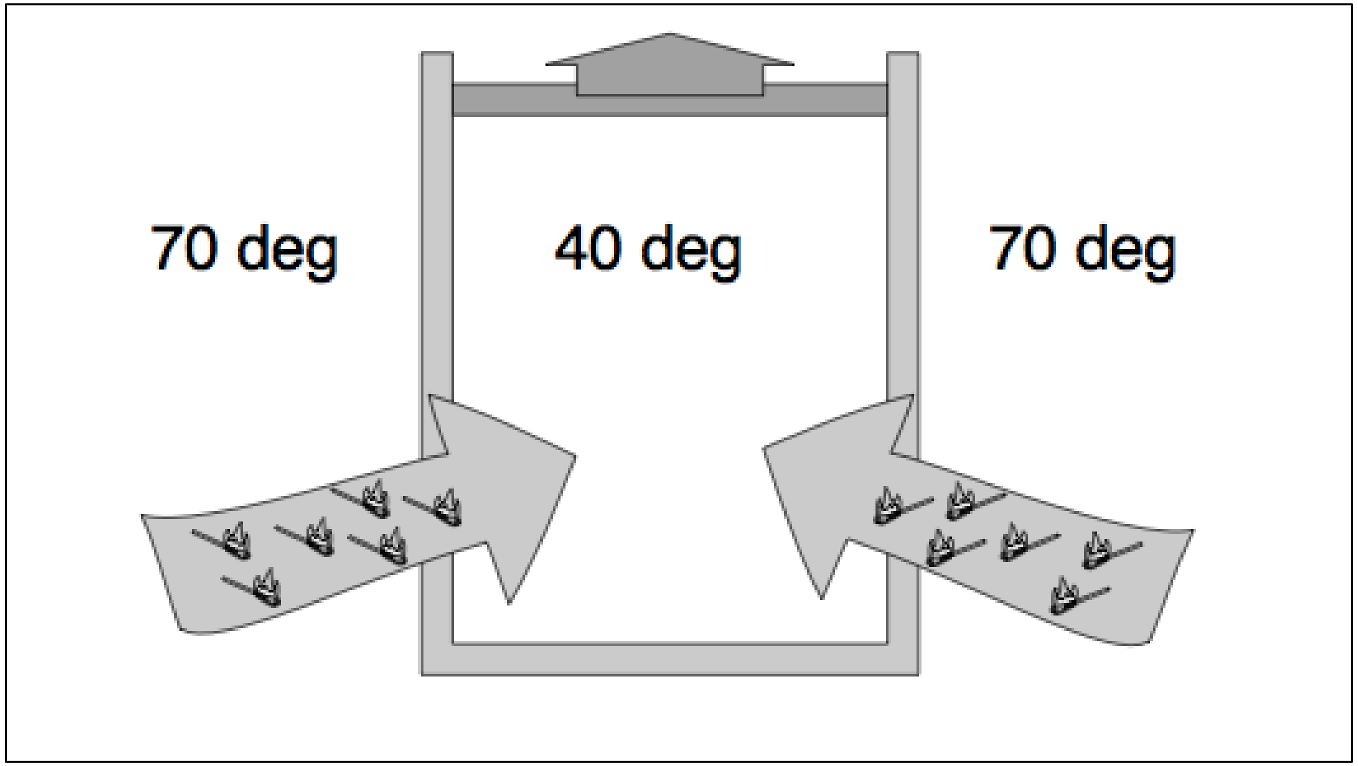
3. SUPER BASIC THERMODYNAMICS AND THE REFRIGERATION CYCLE

- A volume of compressible fluid can have its temperature reduced by expanding it to a larger volume.
- If the temperature is lower than the air around it, heat will naturally go into the container from the air.



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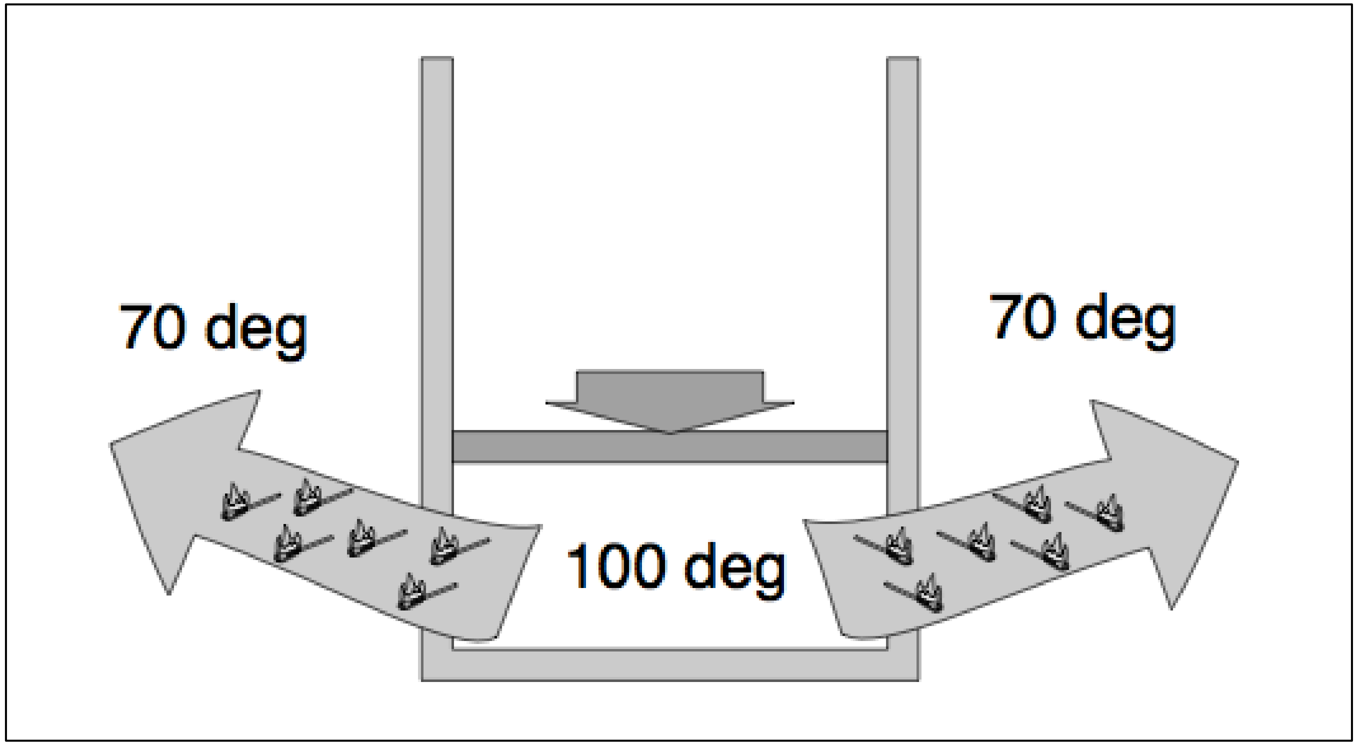
3. SUPER BASIC THERMODYNAMICS AND THE REFRIGERATION CYCLE

- Similarly, a volume of compressible fluid can have its temperature raised by compressing it into a smaller volume.
- If the temperature is greater than the air around it, heat will naturally leave the container to the air.



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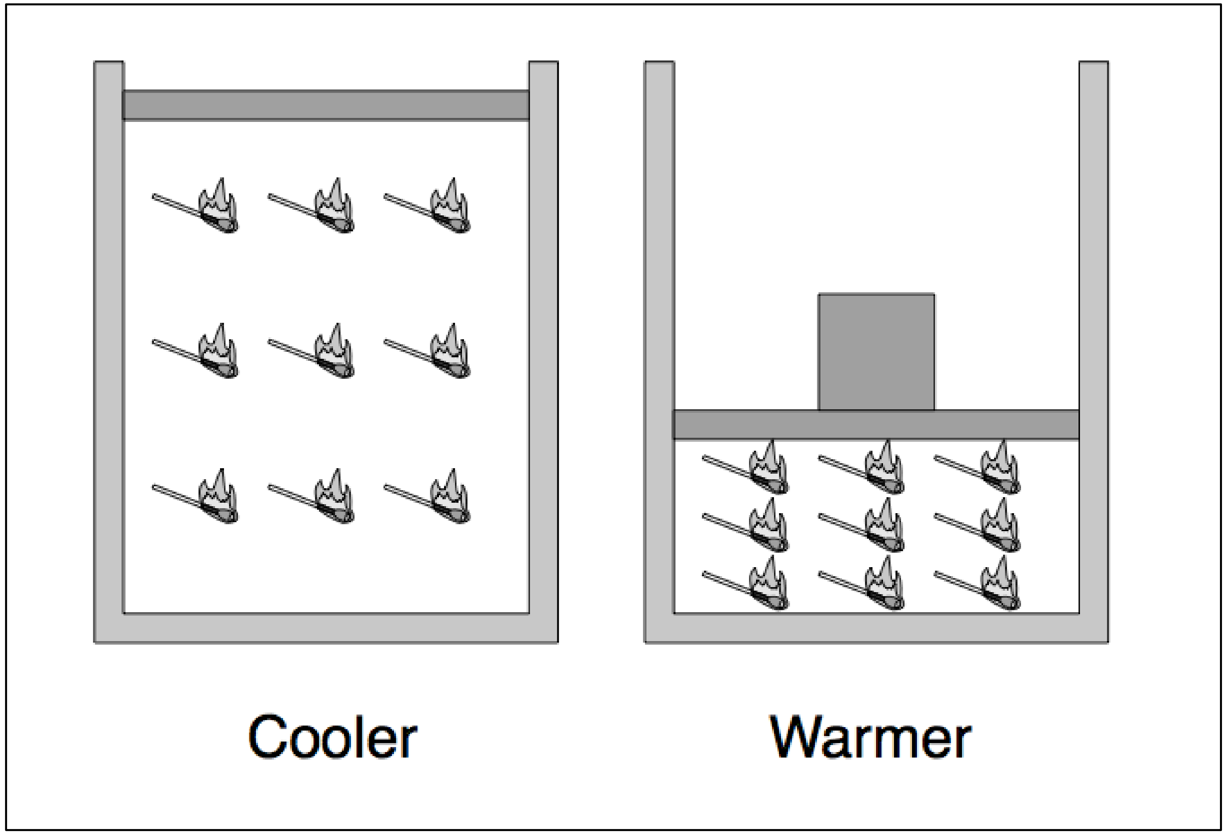
3. SUPER BASIC THERMODYNAMICS AND THE REFRIGERATION CYCLE

- The ability to mechanically change the temperature of a fluid (gas), by changing its volume, is a very important concept in understanding air conditioning and refrigeration.



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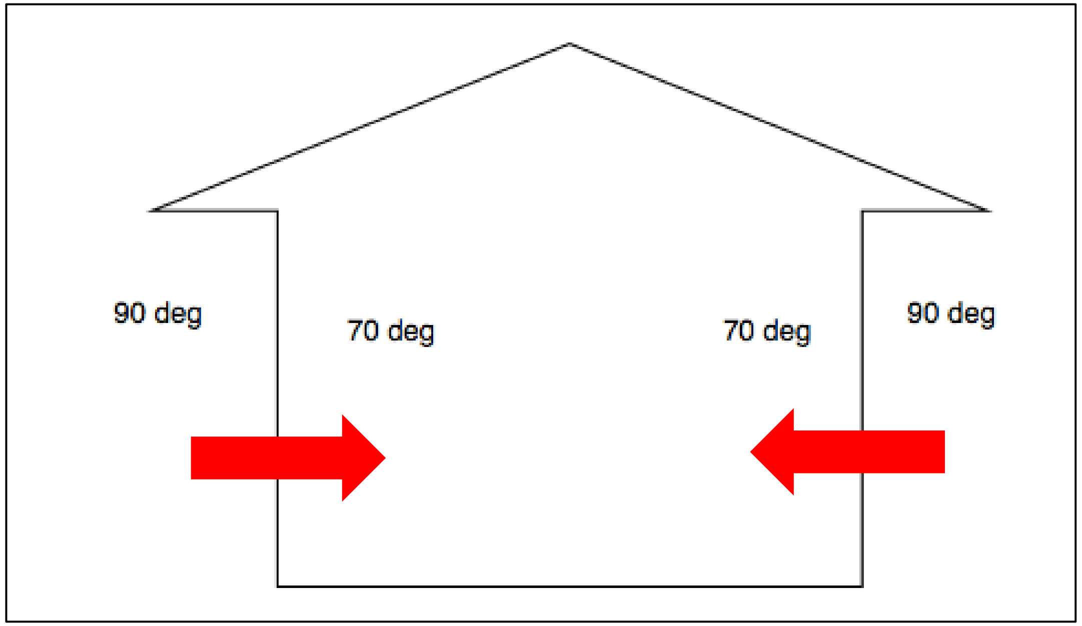
3. SUPER BASIC THERMODYNAMICS AND THE REFRIGERATION CYCLE

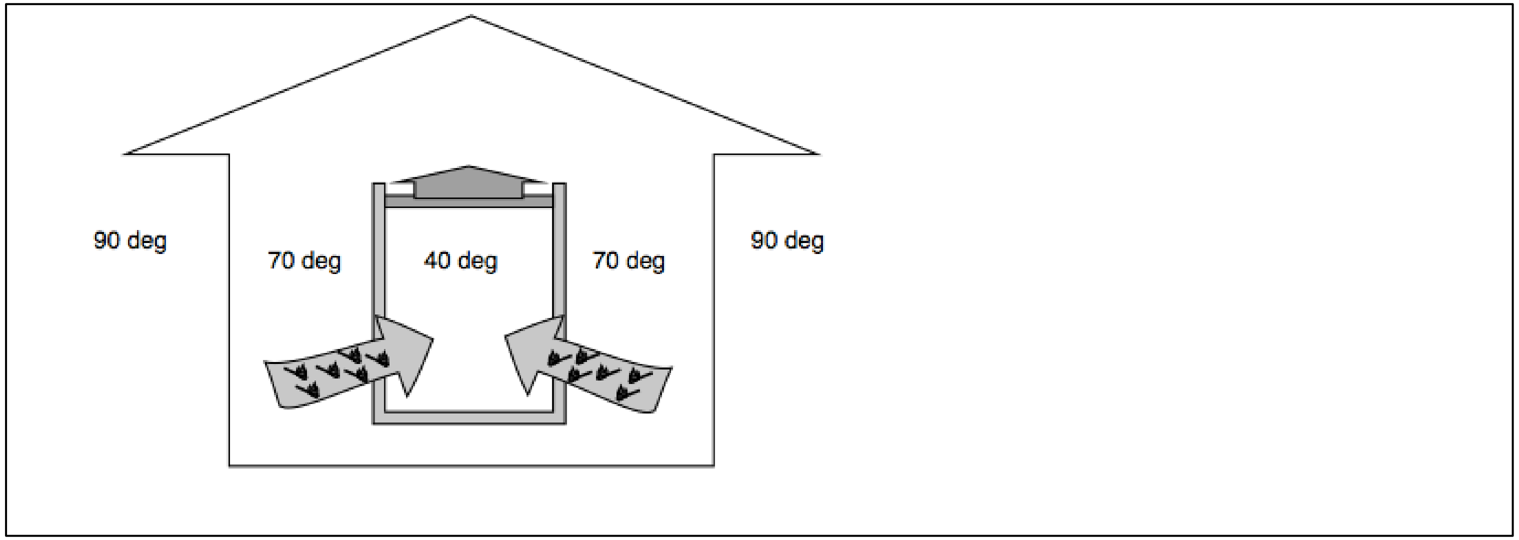
- Let's say we have a house that is 70 degrees inside and it is 90 degrees outside.
- BTUs are coming into the house through convection, conduction and radiation. We need to get them out, otherwise eventually, the 70 deg will become 90 deg.



- To prevent this from happening, we need to remove the BTUs at the same rate that they are coming in.

3. SUPER BASIC THERMODYNAMICS AND THE REFRIGERATION CYCLE

- If we take a vessel of this special compressible fluid inside the house and mechanically expand it so that the temperature is lower than the temperature inside the house, say 40 deg, it will absorb BTU's from the house.



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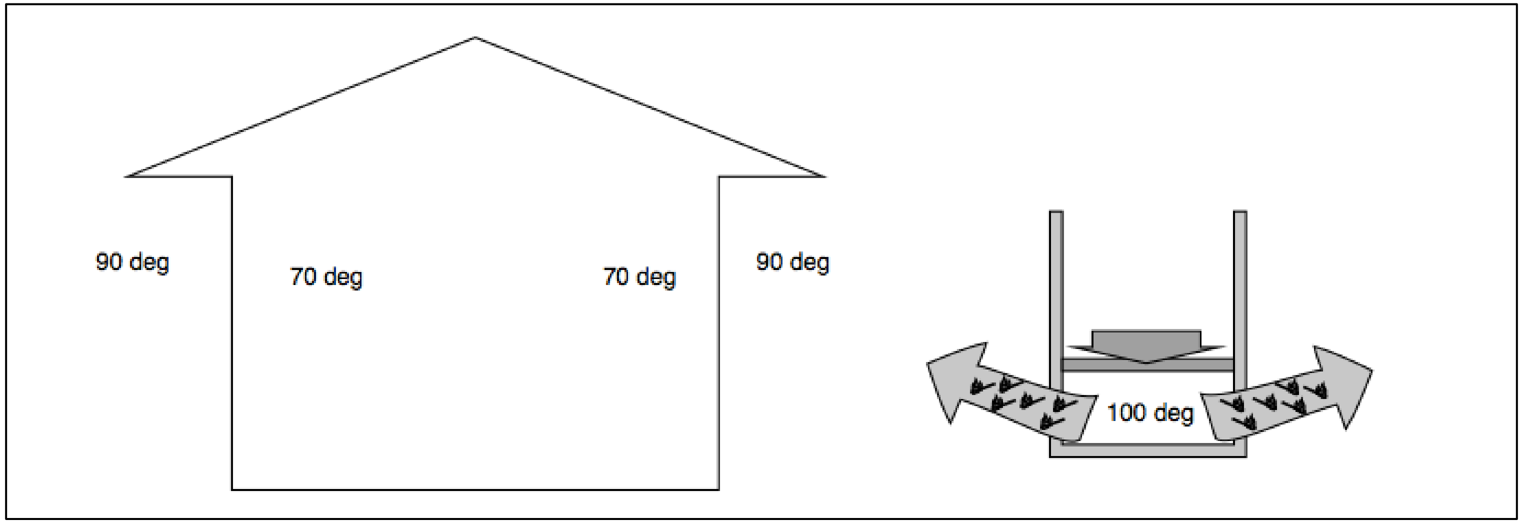
3. SUPER BASIC THERMODYNAMICS AND THE REFRIGERATION CYCLE

- If we then took it outside and compressed it so that its temperature was greater than the air outside, say 100 degrees, BTU's would naturally move to the outside air.



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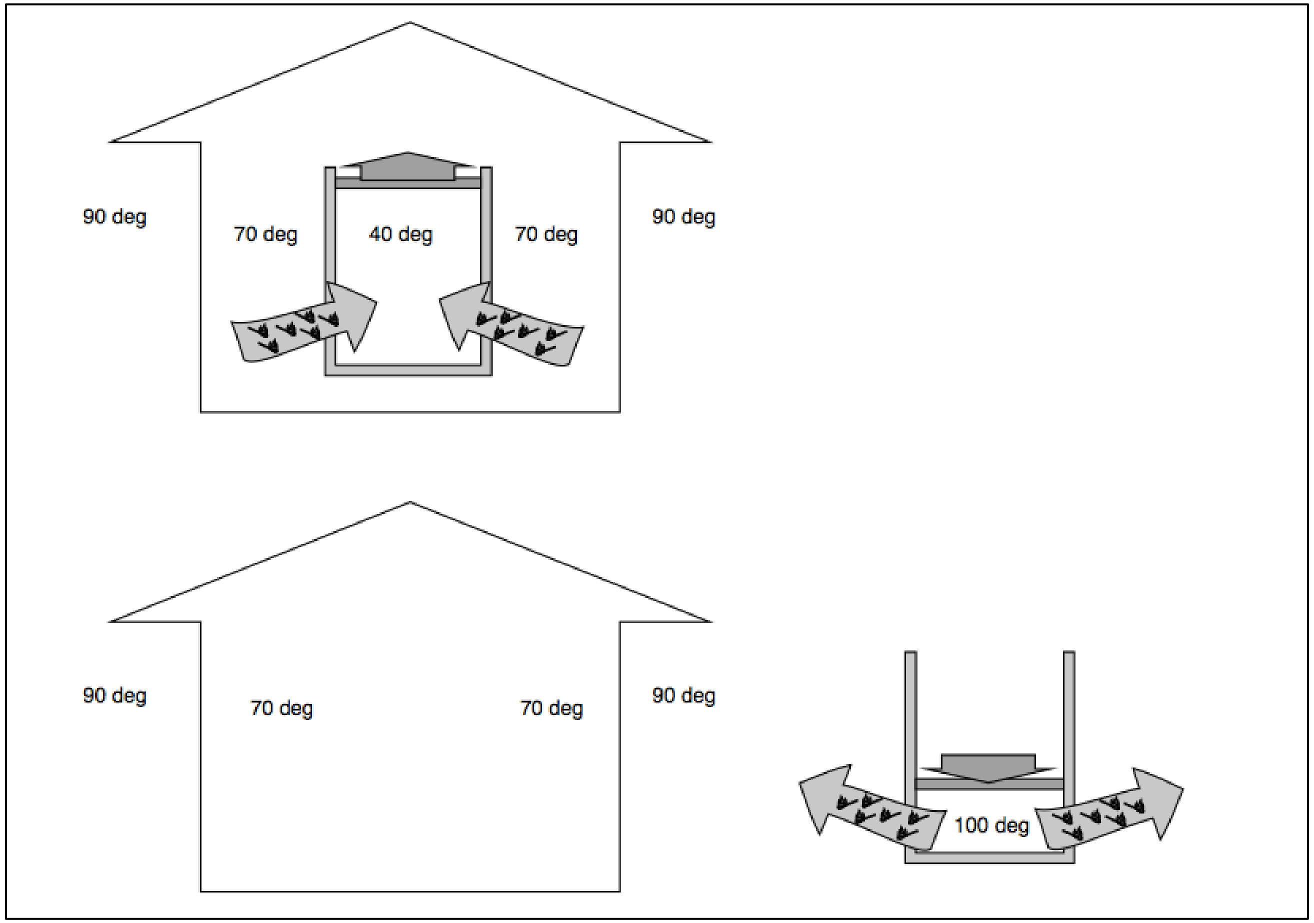
3. SUPER BASIC THERMODYNAMICS AND THE REFRIGERATION CYCLE

- We have just mechanically moved BTUs in the opposite direction than the laws of physics say they should naturally go.
- We have moved them from a cooler indoors to a hotter outdoors.
- SPOILER ALERT: We can do the same thing in the opposite direction when it is colder outside!!



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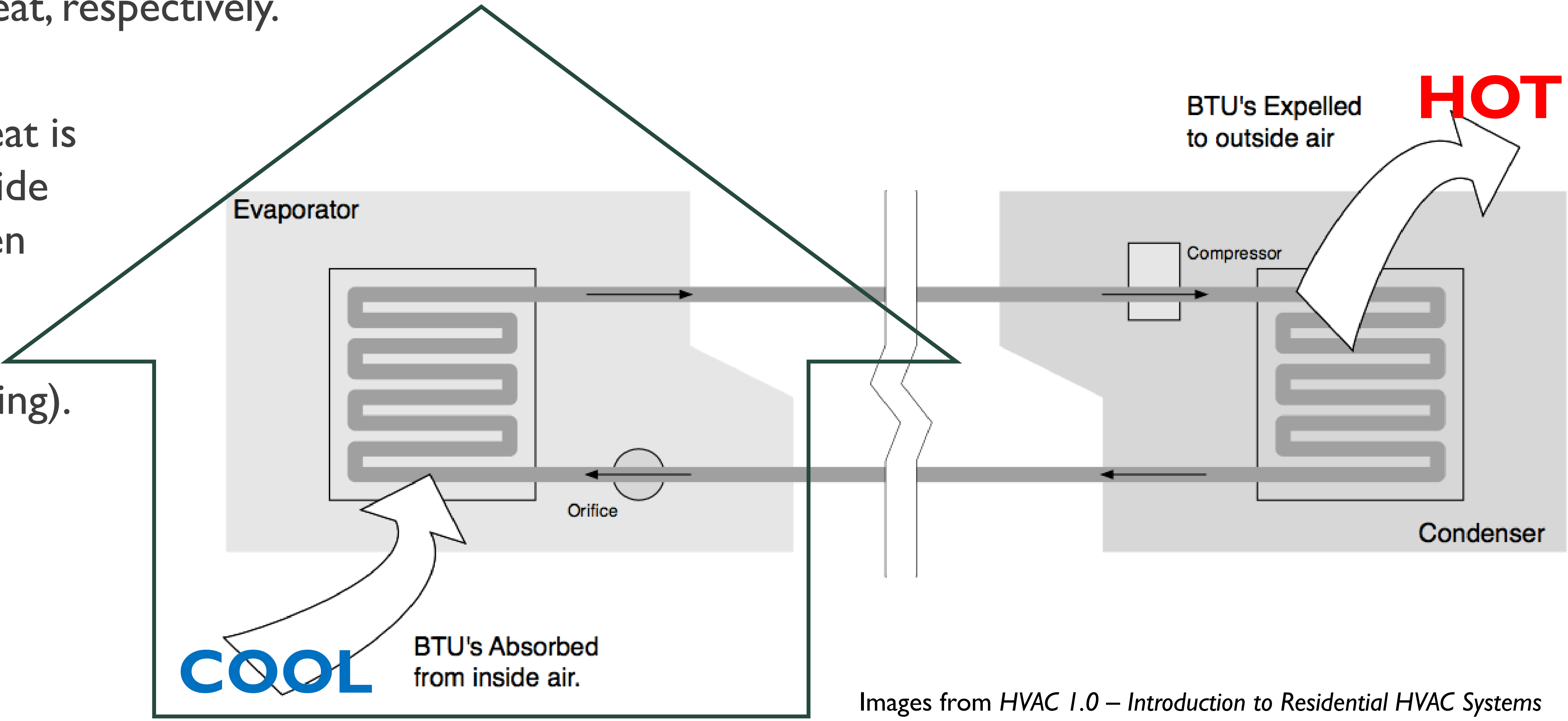
3. SUPER BASIC THERMODYNAMICS AND THE REFRIGERATION CYCLE

- Instead of using fixed sized vessels that are compressed and expanded and moved in and out of the house, we use a loop of pipe and two "coils" where the gas can be expanded or compressed and absorb or expel heat, respectively.

- Notice that the heat is going from the inside to the outside, even though it is hotter outside. This is air conditioning (cooling).

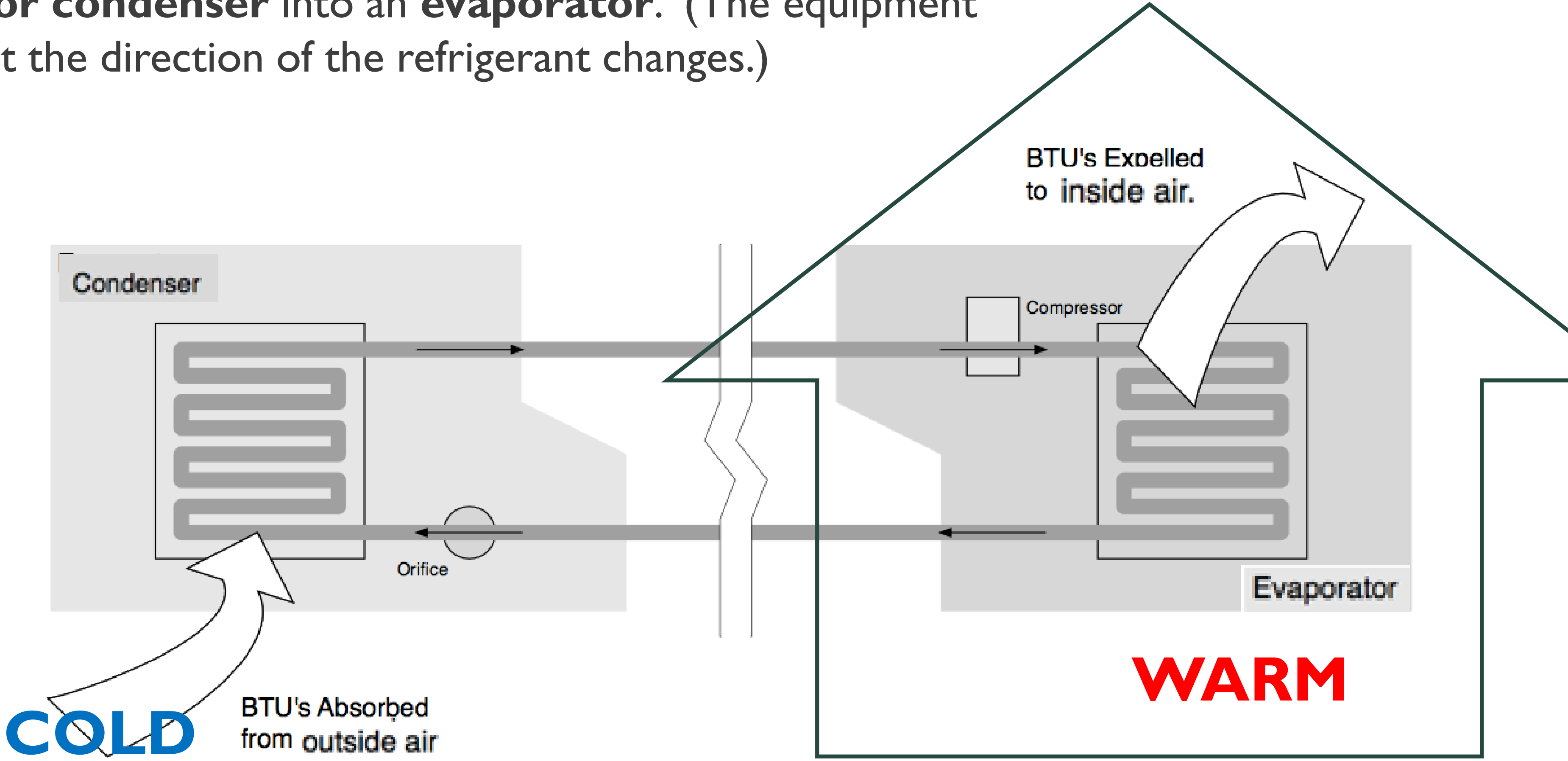


Images from *HVAC 1.0 – Introduction to Residential HVAC Systems*

3. SUPER BASIC THERMODYNAMICS AND THE REFRIGERATION CYCLE

- A heat pump has a reversing valve that turns the **indoor evaporator** into a **condenser** and the **outdoor condenser** into an **evaporator**. (The equipment stays exactly where it is. Just the direction of the refrigerant changes.)

- The heat is absorbed from the cold outdoor air and mechanically transferred to the warmer indoor air.



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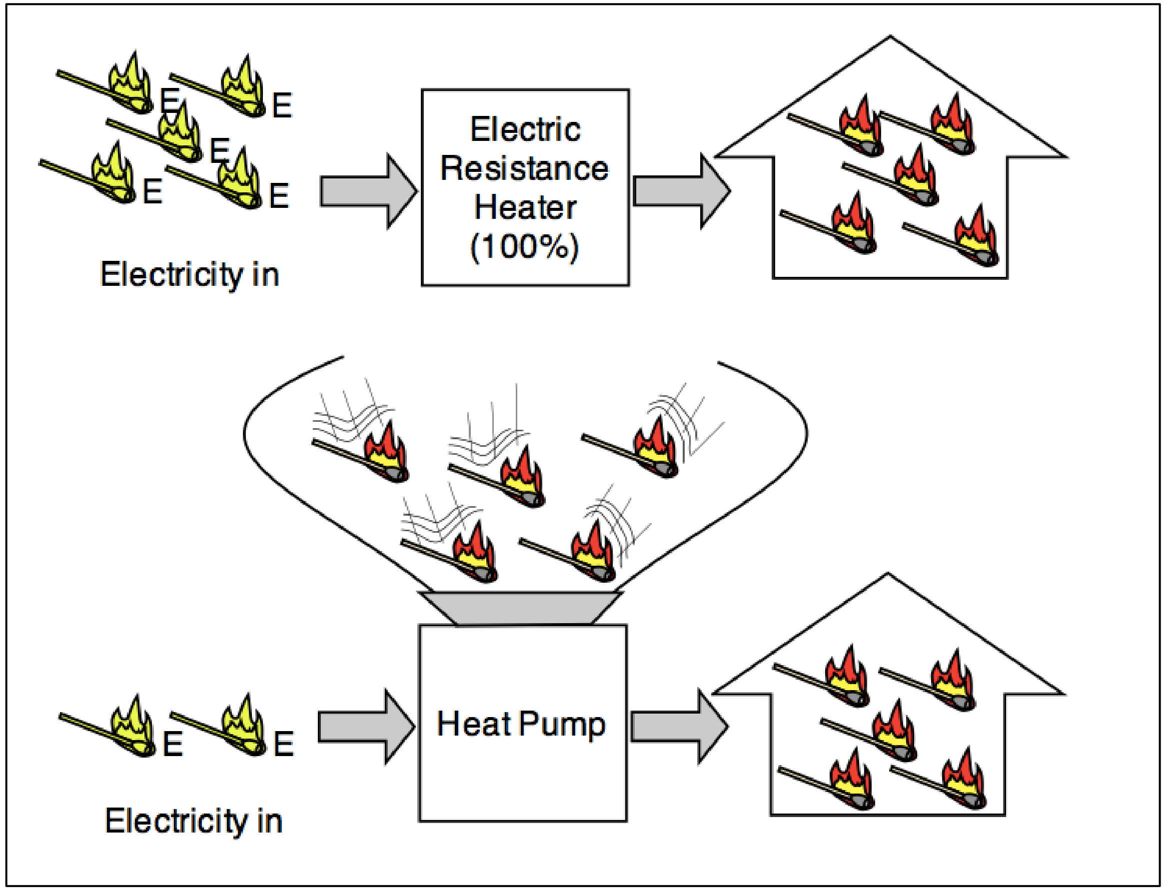
3. SUPER BASIC THERMODYNAMICS AND THE REFRIGERATION CYCLE

So, what is a "Heat Pump"?

- Heat pumps are electric heaters.
- Rather than using electricity to **create** heat like electric resistance heaters, they use a compressor and refrigerant to condense and **move** heat.
- **It takes MUCH less electricity to move heat than to create it.**
- This is what makes heat pumps super efficient and cost effective – even compared to gas.



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4. ADVANTAGES OF HEAT PUMPS FOR SPACE HEATING

4. ADVANTAGES OF HEAT PUMPS FOR SPACE HEATING

- **Air conditioners** have been around since the 1930's. They are a proven technology.
- **Air conditioners** move heat from colder (inside) to warmer (outside) via the refrigerant cycle.
- **Heat pumps** move heat from colder (outside) to warmer (inside) via the refrigerant cycle.
- **Heat pumps** are basically air conditioners that run backwards in the winter.

"Every heat pump comes with a free air conditioner!"

4. ADVANTAGES OF HEAT PUMPS FOR SPACE HEATING

"How cold can it be before a heat pump will stop working?"

- How cold is it inside your coldest freezer?
- Your freezer is a heat pump moving heat from inside your freezer to the outside (garage, house, etc.)
- If it can pull heat out of a VERY cold freezer, it will pull heat out of cold night air.

4. ADVANTAGES OF HEAT PUMPS FOR SPACE HEATING

- Heat pumps are being successfully installed in some of the coldest regions in the world.
- They are **ideal** for the Central Coast climate.
- **Supplementary** electric resistance heat (for extra cold nights) is not necessary in our climate.
- Heat pumps can have **back up** electric resistance heating for emergencies only.

4. ADVANTAGES OF HEAT PUMPS FOR SPACE HEATING

Advantages of Heat Pump Space Heating:

- **Safer –**
  - No gas explosion danger
  - No poisonous combustion gasses (CO)
  - No fire hazards

"The potential for something to go very, very wrong with a gas furnace is much higher than people realize. This is why CO detectors are required by code when you pretty much do anything to your house, including add a sink."

4. ADVANTAGES OF HEAT PUMPS FOR SPACE HEATING

Advantages of Heat Pump Space Heating:

- **Simpler and cheaper installation** –
  - No gas pipes
  - No flue vents (no roof penetrations needed)
  - No combustion air vents

4. ADVANTAGES OF HEAT PUMPS FOR SPACE HEATING

Advantages of Heat Pump Space Heating:

- **Lower maintenance** –
  - Combustion appliances must be checked and adjusted regularly
  - No gas burner ports to become clogged or dirty
  - No safety devices to fail
  - No gas condensate to drain or pump out

(Exception: ductless mini-splits do require frequent cleaning.)

4. ADVANTAGES OF HEAT PUMPS FOR SPACE HEATING

Advantages of Heat Pump Space Heating:

- **Smaller sizes available to match smaller loads**
  - Better load vs capacity sizing
  - more efficient buildings
  - easier zoning of smaller spaces within a home

4. ADVANTAGES OF HEAT PUMPS FOR SPACE HEATING

Advantages of Heat Pump Space Heating:

- **Cleaner** –
  - no carbon emissions (depending on utility generation – getting better)
  - can utilize roof-top solar/renewables

4. ADVANTAGES OF HEAT PUMPS FOR SPACE HEATING

Advantages of Heat Pump Space Heating:

- **Super efficient** –
  - moves heat that already exists, rather than creating it (300%+ efficient),
  - super advanced technology incorporated into equipment
- **Cost effective** – in many markets heat pumps can compete with gas on a cost per BTU-delivered basis – it depends heavily on rates and time of use.

Heat pump heating efficiency is rated by HSPF
Heat pump cooling efficiency is rated by SEER/EER

4. ADVANTAGES OF HEAT PUMPS FOR SPACE HEATING

Disadvantages of Heat Pump Space Heating:

- **More complicated equipment** – requires more qualified technicians (similar to cars – more are being trained every day)
- **More complicated controls** – if not set correctly they can blow cold air during defrost cycle or try to run on supplementary electric heat unnecessarily.
  - Can be a bit more difficult to operate by homeowners. They require more attention.

4. ADVANTAGES OF HEAT PUMPS FOR SPACE HEATING

Disadvantages of Heat Pump Space Heating:

- **Can be impacted by bad design/installation** –
  - Designers must be more careful with load calcs, equipment sizing and duct design
  - These have all been required by code for years, but few contractors take the time to do them.
  - It's time contractors start doing what they are supposed to do.
  - If a contractor tries to talk you out of a heat pump system, find another contractor or a third-party consultant.

4. ADVANTAGES OF HEAT PUMPS FOR SPACE HEATING

Disadvantages of Heat Pump Space Heating:

- **Grid Reliability Issues** – More demand on the grid increases potential for failure.
  - This is being addressed and improves every day.
  - Making houses much more efficient so that they work with smaller equipment will reduce demand on grid.
- **May require upgraded electrical panel if** switching from gas, (there are rebates to help cover these costs and many options to help avoid having to upgrade panel)

4. ADVANTAGES OF HEAT PUMPS FOR SPACE HEATING

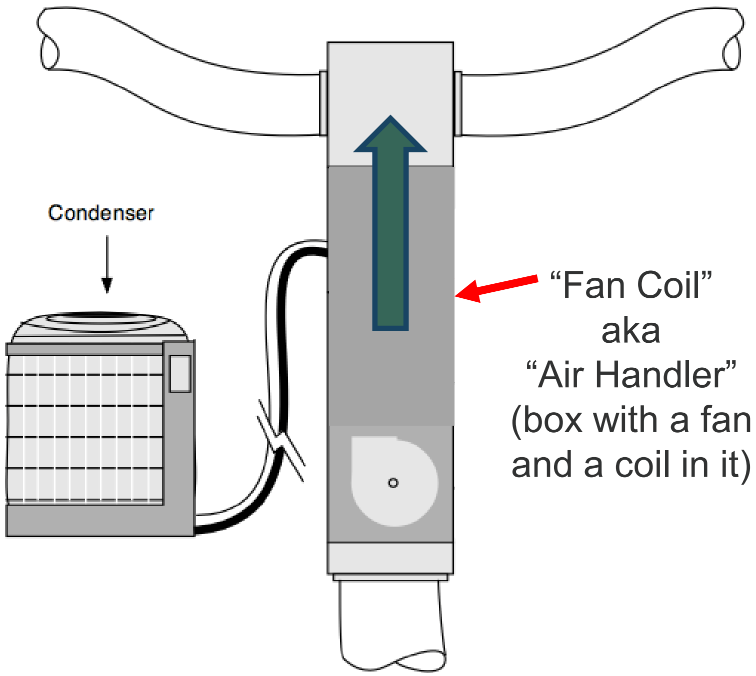
All the disadvantages are avoidable, manageable, and are improving over time.

5. TYPES OF HEAT PUMPS FOR SPACE HEATING

5. TYPES OF HEAT PUMPS FOR SPACE HEATING

Heat pumps come in a variety of configurations:

- Ducted "split systems" have been around for years and resemble standard gas furnace central systems.
- They have a "Fan coil unit" instead of a gas furnace and an integrated evaporator coil.
- No gas lines, no flue vents, no combustion air, no safety devices needed



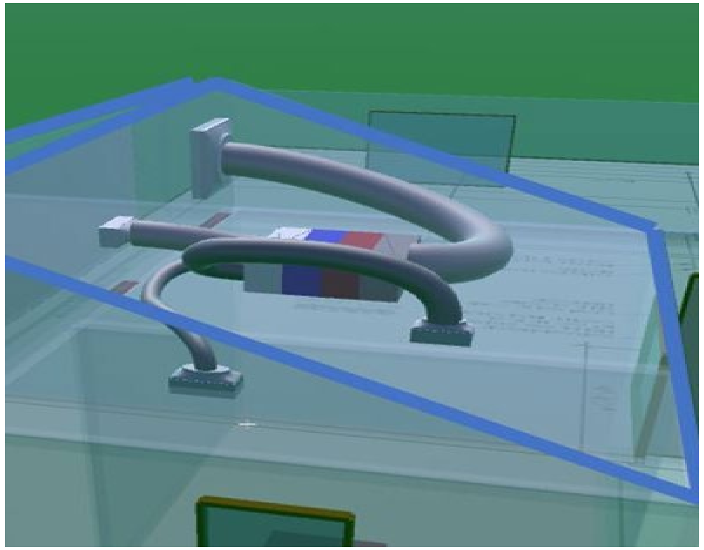
A Typical Split System Heat Pump

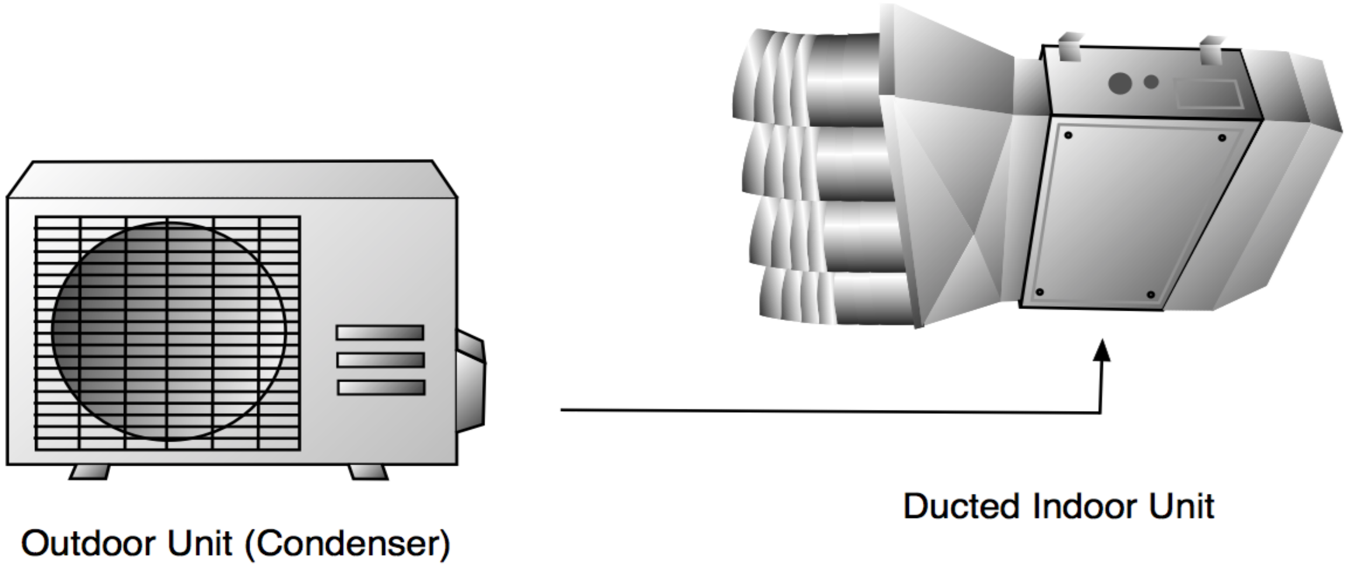
Image from *HVAC 1.0 – Introduction to Residential HVAC Systems*

5. TYPES OF HEAT PUMPS FOR SPACE HEATING

Ducted "Mini-Splits" –

Single head or multi-head



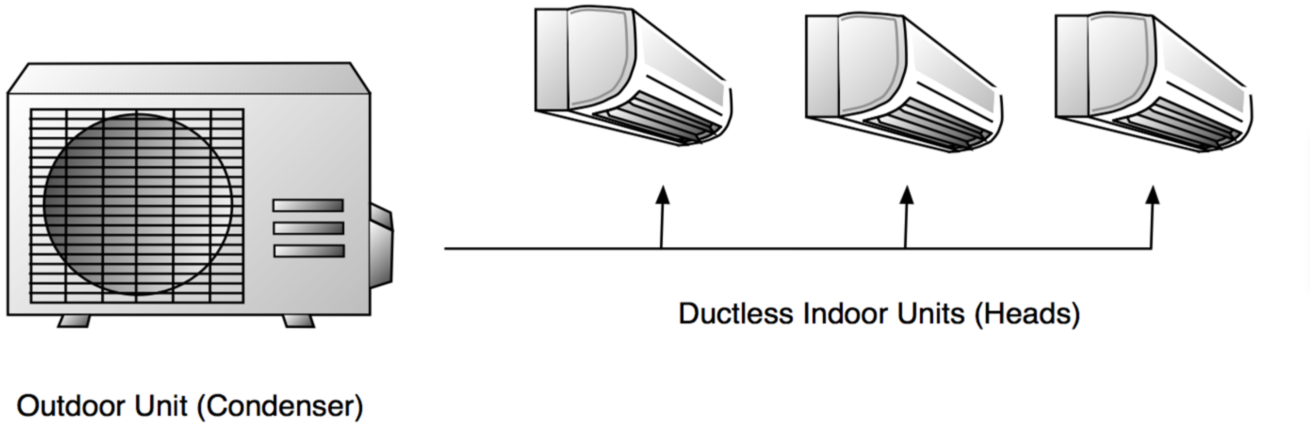


Example of a Single Head, Ducted Mini-split

5. TYPES OF HEAT PUMPS FOR SPACE HEATING

Ductless "Mini-Splits" –

Single head or multi-head



Example of a Multi-Head, Ductless Mini-split

Wall Cassette (ductless)

Ceiling Cassette (ductless)

Ducted and ductless heads can be mixed on multi-head condensers.

5. TYPES OF HEAT PUMPS FOR SPACE HEATING

- Typical heat pumps are called **air source heat pumps.** They get their BTUs from the air.
- The BTUs don't have to just come from air.
  - There are **water source** heat pumps that get their heat from a water source.
  - There are **geothermal** heat pumps that get their heat from the ground.

6. SIZING HEAT PUMPS

6. SIZING HEAT PUMPS

- Heat Pumps provide both heating and cooling from a single compressor/condenser.
- Because there is only one compressor/condenser, the heating and cooling capacities are fixed relative to each other.
- Depending on the climate, the heat pump could be sized fine for cooling but undersized for heating and vice versa.

6. SIZING HEAT PUMPS

- Be sure to use a qualified licensed contractor that understands:
  - ACCA Manual J – Load Calculations
  - ACCA Manual S – Equipment Selection*
  - ACCA Manual D – Duct Design

* a new version of Manual S has been released (2023). It has a much greater focus on heat pumps and more sizing options.

6. SIZING HEAT PUMPS

- Historically, most designers would size the heat pump for cooling and make up the heating capacity shortfall (if any) with electric resistance strips.
- Research, field studies, and improvements in heat pump technology all show that heat pump systems in CA do not need supplementary resistance electric strips.
- Heat pumps are working fine in all CA climates, including Tahoe/Truckee, without supplementary heat strips.

6. SIZING HEAT PUMPS

- The general recommendation today is to size the heat pump to the **larger** of the heating or cooling load and it *might* be a bit oversized for the other load.
- Any potential oversizing problems are negated by
  1. Good duct design and airflow
  2. Variable capacity or two stage heat pumps

6. SIZING HEAT PUMPS

- As long as your heat pump heating capacity is properly sized to handle the heating load without heat strips, the heat strips should never come on.
- You can install them as emergency backup heat as long as you have good controls to limit their use (emergency only, not supplementary).

6. SIZING HEAT PUMPS

- Heating setbacks are generally not needed or recommended for heat pumps. You can let the house cool down at night, just be sure to give it plenty of time to warm back up in the morning.
- One of the most common problems with new heat pump systems is that the installers are not familiar with the controls and commissioning.
- They frequently must come back to adjust something. Be patient as installers get more experience.

HEAT PUMPS FOR RESIDENTIAL WATER HEATING

UNDERSTANDING HEAT PUMPS FOR RESIDENTIAL WATER HEATING

1. Introduction
2. Super Basic Thermodynamics and the Refrigeration Cycle
3. Advantages of Heat Pumps for Water Heating
4. Identifying Heat Pump Water Heaters
5. Special Considerations for Heat Pump Water Heating
6. Open Discussion, Q&A

I. INTRODUCTION

Instantaneous Water Heating

- Water is heated from the incoming cold temperature to a "hot" temperature instantly, as it is needed. Aka, On Demand, Tankless, etc.
- Advantages: A large amount of hot water does not need to be kept at temperature for a long time. (No standby losses) Ideal for vacation homes or infrequent uses.
- Disadvantages: Require very high input (larger gas pipe or electric circuit), have inefficiencies in the heat exchanger – harder to heat water that is moving by quickly. Reduced flow rates – e.g., you can only take limited showers simultaneously

Photo credit: BayREN/Frontier Energy

I. INTRODUCTION

Storage Water heating

- A large amount of hot water (typically 40-80 gallons) kept hot all the time, to be used as needed.
- Advantages: Can have many simultaneous draws (showers) until hot water is depleted. Can take advantage of more efficient heating sources (heat pump and solar). Can be used as energy storage (grid integration).
- Disadvantages: Hot water can "run out". Slower recovery times. Standby losses of keeping water hot when not being used - Can be reduced by better tank insulation and scheduling.

1. INTRODUCTION

- A note about Recirculating Systems – a pumped loop of hot water intended to reduce the wait time for hot water at the point of use.
  - Can save water, but wastes energy
  - Continuous or timed – extremely wasteful of heat
  - On demand – much better, push button better than sensor. Can be retrofitted.
  - Always, always insulate recirc system piping

Comparison of Water Heating Fuel Types

	Gas	Electric Resistance	Electric Heat Pump
Install cost	Low (if replacing gas) ✓	Low (if replacing same)	High (but rebates)
Operation costs	Low	High	Low (esp. with solar) ✓
Safety	Bad ✗	Med	Good ✓
Environmental	Bad ✗	Med	Good ✓
Performance	High ✓	Med	Low (but manageable)

SUPER BASIC THERMODYNAMICS AND THE REFRIGERATION CYCLE

Heat Pump Water Heaters

- They use the refrigeration cycle to move BTUs from the air around them into the water inside them.
- The warmer the air is, the better they work
- This is still much more efficient that resistance electric and cost competitive with gas water heaters.

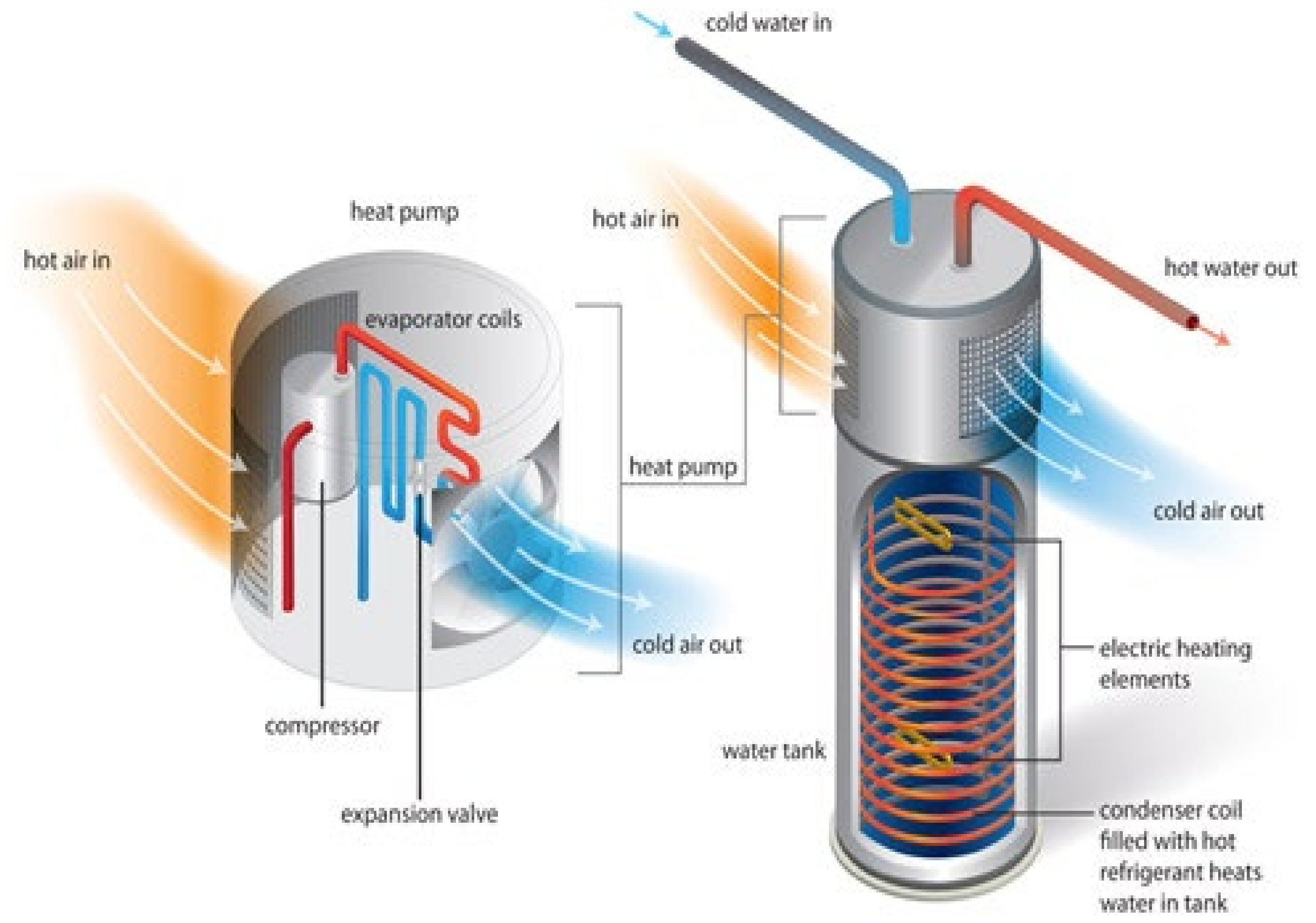


Photo credit: EnergyStar

ADVANTAGES OF HEAT PUMPS FOR WATER HEATING

Advantages of Heat Pump water Heating:

- **Super efficient** –
  - moves heat that already exists, rather than creating it (300%+ efficient),
  - super advanced technology incorporated into equipment (Wi-Fi controls)
- **Cost effective** – in many markets heat pumps can compete with gas on a cost per BTU-delivered basis – it depends heavily on rates and time of use.

Photo credit: Eco-$mart

ADVANTAGES OF HEAT PUMPS FOR WATER HEATING

Disadvantages of Heat Pump water Heating:

- **More complicated equipment** – requires more qualified technicians (like cars – more are being trained every day)
- **More complicated controls** – if not set correctly they can run on supplementary electric heat unnecessarily.
  - Can be a bit more difficult to operate by homeowners. They require more attention.

ADVANTAGES OF HEAT PUMPS FOR WATER HEATING

Disadvantages of Heat Pump water Heating:

- **Grid Reliability Issues** – More demand on the grid increases potential for failure.
  - This is being addressed and improves every day.
- **May require upgraded electrical panel if** switching from gas, (there are rebates to help cover these costs)

ADVANTAGES OF HEAT PUMPS FOR WATER HEATING

All of the disadvantages of heat pump water heaters are avoidable or are improving over time.

4. IDENTIFYING HEAT PUMP WATER HEATERS

THE CURRENT MARKET

- Common characteristics
  - Storage tanks: 40 – 80 gallons, larger sizes available for MF
  - Heat pump electric draw: Typically ~1.3 kW
  - Resistance element electric draw: Typically 4 – 5 kW

IDENTIFYING HPWHS – 2 BASIC TYPES

- Integrated
  - Heat pump equipment on top of the storage tank
  - The entire system is contained in a single component

Image credit:
A. O. Smith

- Split
  - The condenser for the heat pump is split from the rest of the unit
  - Allows installation of condenser outside

Image credit:
Sanden

Slide Credit: BayREN

IDENTIFYING INTEGRATED HPWHS

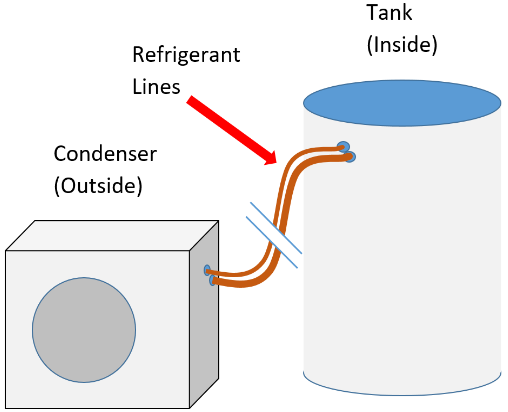
- Features:
  - Heat pump on top of storage tank
  - Control panel
  - Air vents for heat pump
  - Large storage tank
  - Electrical connection
  - No gas connection

Photo credit: A. O. Smith

Slide Credit: BayREN

IDENTIFYING SPLIT HPWHS

- Features:
  - No Heat pump on top of tank
  - Large storage tank
  - Control panel
  - Electrical connection
  - No gas connection
  - Condenser is a separate component
  - Water/ Refrigerant lines running between condenser and tank (like a mini-split space heating system)



Slide Credit: BayREN

Photo credit: Sanden

DIFFERENTIATING FROM ELECTRIC RESISTANCE

- Features
  - No heat pump on top
  - Large storage tank
  - Electrical connection (240v)
  - No gas connection
  - **Only** electric resistance elements

Photo credit: Rheem

Slide Credit: BayREN

DIFFERENTIATING FROM GAS STORAGE

- Features:
  - Flue gas piping
  - Large storage tank
  - Gas Connection
  - Temperature adjustment knob instead of control panel

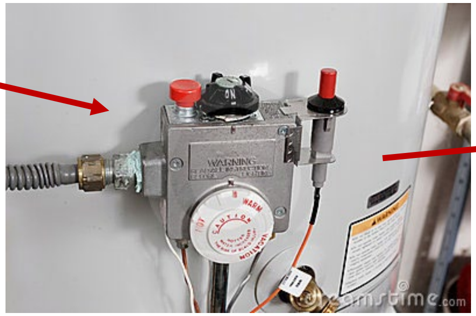


Photo credit: Bradford White

Slide Credit: BayREN

5. SPECIAL CONSIDERATIONS FOR HEAT PUMP WATER HEATERS

SPECIAL CONSIDERATIONS FOR HEAT PUMP WATER HEATERS

Electrical Panel

- Most require 240 V, 30A electrical supply
- May require upgrade to electrical panel if switching from gas.
- Some new products require 240 V, **15A**
- Some are also **115 V**, 15A-20A
- There are controls available for sharing circuits that gives priority to one use over another (e.g., dryer over water heater, or stove over EV)

SPECIAL CONSIDERATIONS FOR HEAT PUMP WATER HEATERS

Ventilation

- HPWH get their heat from the air, so they require adequate **volume or ventilation**
  - 750 – 1000 cubic feet in room, OR
  - Vents or ducts allowing air flow to/from a neighboring space
- Preferred location - hot spaces such as a garage
- By product is cold air – be creative

SPECIAL CONSIDERATIONS FOR HEAT PUMP WATER HEATERS

Recovery Time

- HPWH take longer to recover (come back to temperature when tank is depleted)
- Replace a gas water heater with a larger heat pump water heater (e.g. 30 gal with 50 gal, 50 gal with 75 gal)
- Most HPWH have electric resistance elements for “emergencies”.

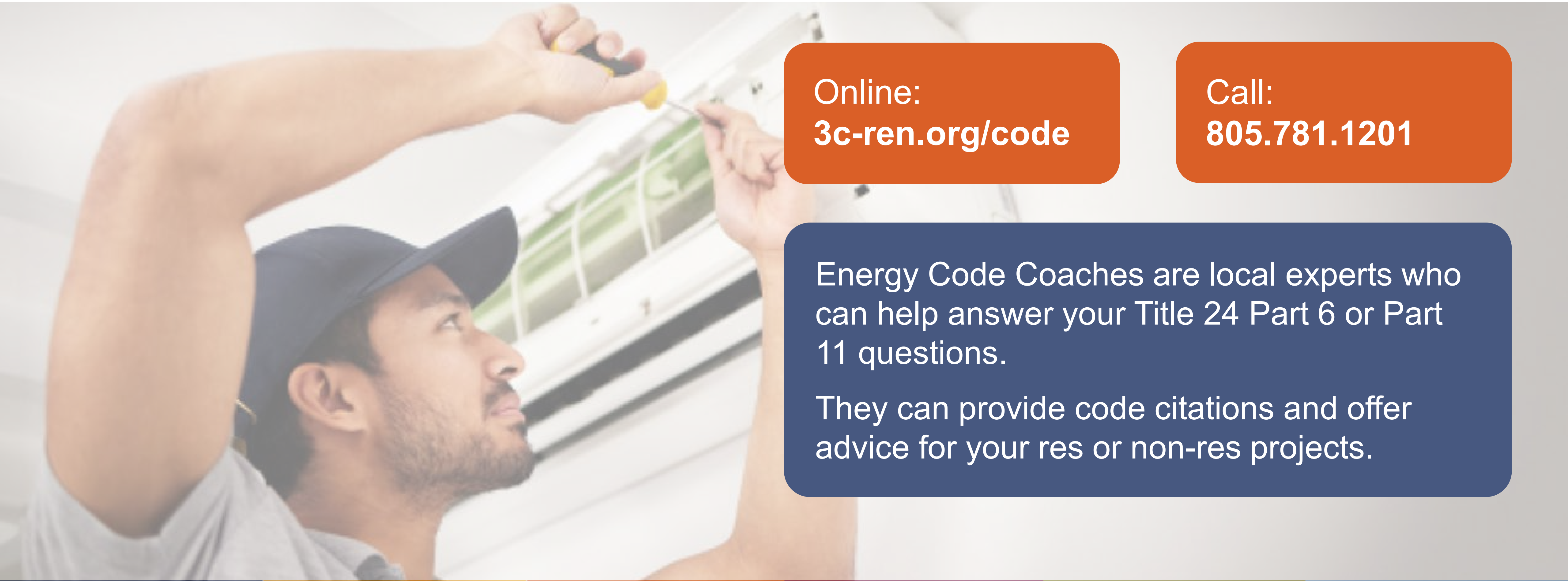
CONTROLS

- Consider models with connected functionality that allow mobile control and status checking.
- Set all controls as per manufacturer's instructions.
- Set temperature set point, if not factory set.
- Heat pump systems have several operating modes depending on manufacturer, such as:
  - Heat pump, Hybrid, Boost, Standard, Vacation
- Heat pump modes can be set for year-round use if the conditions are right.
- Avoid using other modes that may use energy needlessly.

END OF PRESENTATION

Questions about Title 24?

3C-REN offers a *free* Code Coach Service



Online:
3c-ren.org/code

Call:
805.781.1201

Energy Code Coaches are local experts who can help answer your Title 24 Part 6 or Part 11 questions.

They can provide code citations and offer advice for your res or non-res projects.

Closing

Continuing Education Units Available

- Contact dresurreccion@co.slo.ca.us for AIA LUs

Coming to Your Inbox Soon!

- Slides & Recording – Please Take It and Help Us Out!

SNEAK PEEK: Anticipated Courses in Q1 (January – March)

- Unitary vs Split HPWH Systems
- Renewable Energy, Energy Storage, and Resilience
- Navigating the Energy Code
- 2025 Energy Code in Practice: Single Family Residential
- 2025 Energy Code & Passive House
- Builder's Perspective: HPWH

Any phone numbers who joined? Please share your name!

Thank you!

More info: **3c-ren.org**

Questions: **info@3c-ren.org**

Email updates: **3c-ren.org/newsletter**

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