

Heat Pumps 101

Loie Hayes, Green Energy Consumers Alliance

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Agenda

- Introductions
- Heat pump basics
- Costs and incentives
- Design considerations
- Questions?



Heat pump basics

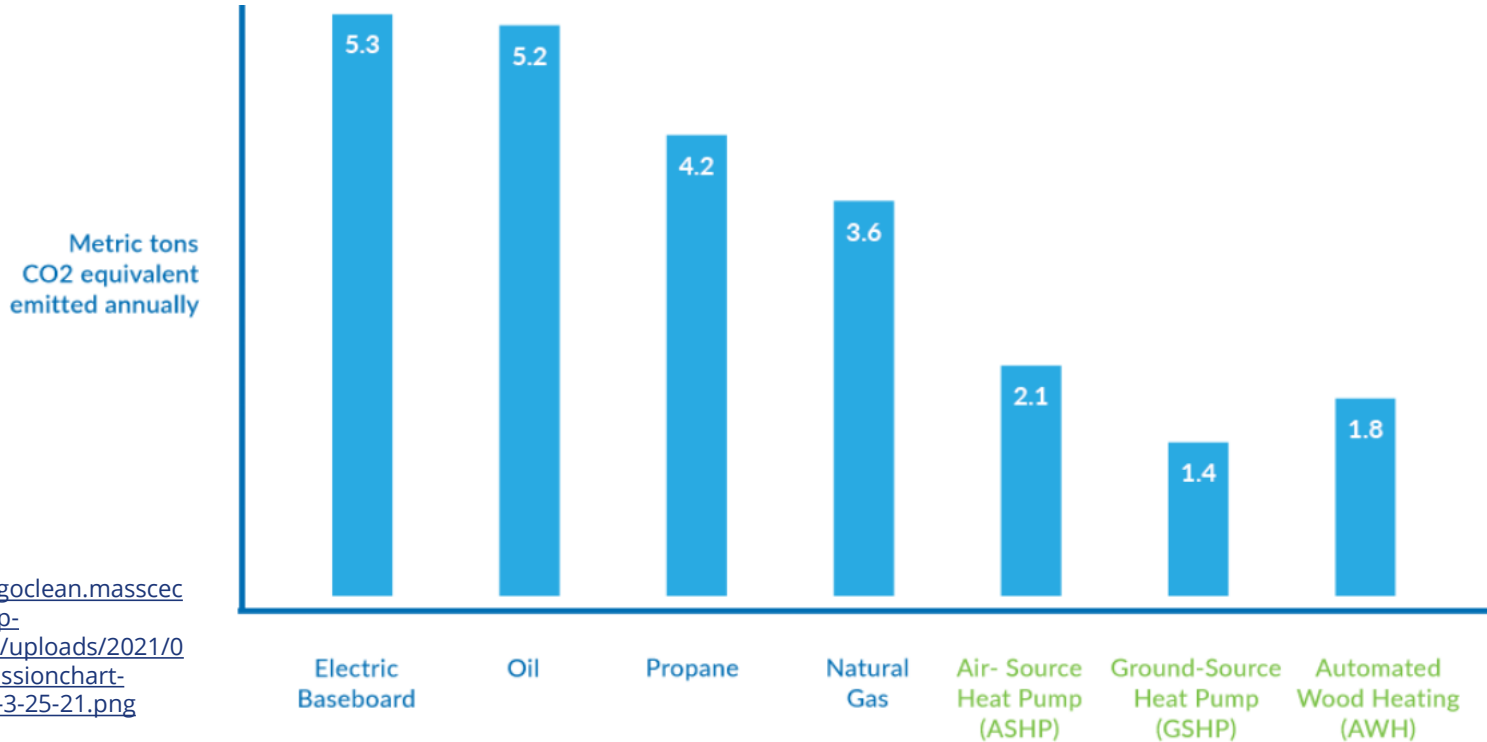
Green Energy Consumers Heat Pump Program

- Green Energy CONSUMERS Alliance
- Big transition to heating without fossil fuel combustion
- Helping energy consumers find trusted vendors and sound advice
- Moving the heat pump industry by educating consumers

More details on our website:

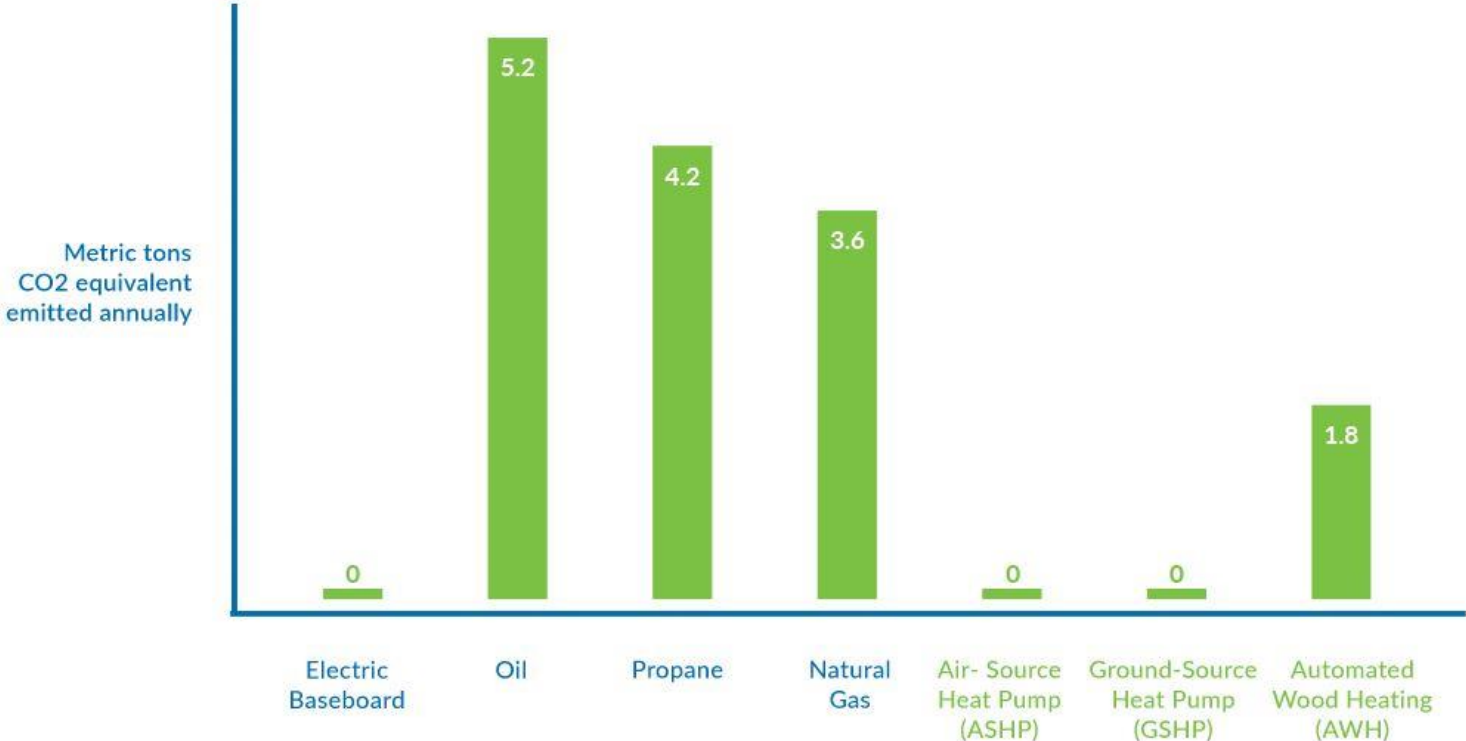
greenenergyconsumers.org/heatpumps

GHG emissions with current electric grid



<https://goclean.masscec.com/wp-content/uploads/2021/03/Emissionchart-revised-3-25-21.png>

GHG emissions with 100% clean electricity



What is a heat pump?



Same technology as:



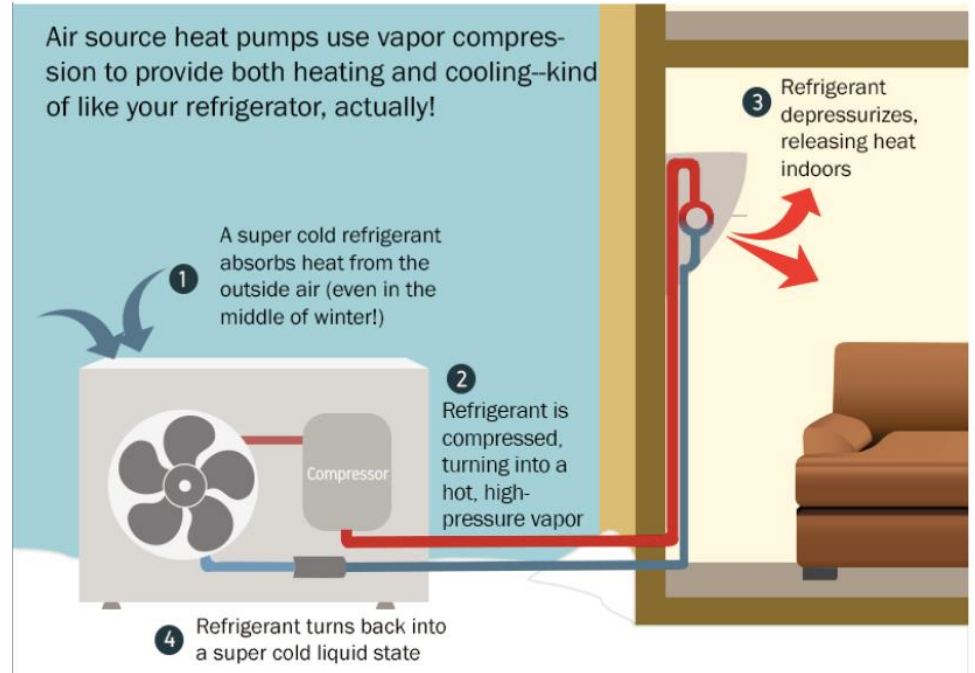
Air
Conditioner



Refrigerator

Heat pumps

- Efficient to very cold temps
- Varied forms
 - Ducted or ductless
 - Whole home or partial
 - Air-source or ground-source



Ductless Indoor Variations (aka heads)

Wall Hung



Floor Mount



Ceiling Cassette



Outdoor Condensers Need Space

- Need free flow of air
- Must be off the ground to prevent ice build up
- Refrigerant line covered



Costs and incentives

Installation costs

- Rough ballpark: single head, ductless: \$6,000 - \$10,000
- Centrally ducted: \$15 - \$25K+
- Roughly comparable to fossil fuel heating + central air
- 200 amp electrical service likely needed
- 0% interest HEAT loan and incentives can offset much of your installation cost



Whole home rebate: Mass Save

- Completely replacing your fossil fuel heating
 - Fossil system must be disconnected
- \$10,000 per home – **regardless of system size**
- Must get Home Energy Assessment first and,
- Weatherize first to reduce your heating needs



Heat pump with fossil fuel backup (MA)

Incentives for partial systems

- Depending on system size, up to \$10,000
 - \$1,250/ton (12,000 BTu)
 - Most homes need 3 to 5 tons

Integrated controls for seamless transitions

- Thermostat connected to both systems
- Technician sets the switch-over point

Ground-source and air-to-water (MA)

- **Ground-source** (aka geothermal) heat pumps: \$15,000 rebate
 - More expensive installation costs due to site work on your property
 - More efficient than air-source
- Air-to-water (aka **hydronic**) heat pumps: \$10,000 rebate
 - Most applicable to radiant flooring
 - Very few experienced installers

Heat pump water heaters

- \$750 “instant” rebate in MA - through contractor
- 2 - 3 times more efficient than electric resistance tanks
- Need adequate space for air exchange
- Electrical wiring – 240 volt circuit
 - Plug-in models not yet available in our region
- Condensate drain
- Makes space colder and dryer



Federal tax credit

- 30% of post-incentive cost, up to \$2,000 for heat pumps and HP water heaters
 - Must meet high standards for efficiency
- Smaller credits for electrical wiring upgrades, and other measures
- No rollover but you can claim a new energy saving tax credit every year for 10 years
- IRA *rebates* coming in 2024: [DOER updates](#)



Federally-funded rebates ...coming...

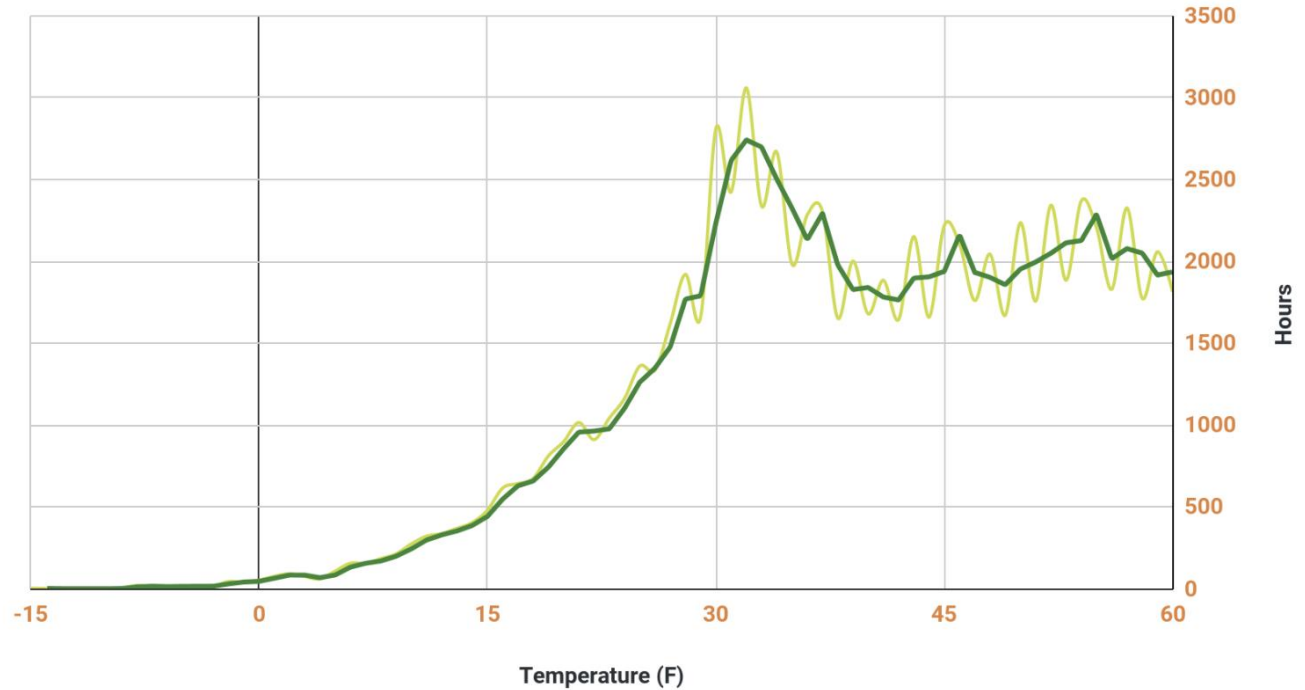
- For all income levels: Home Efficiency Rebate (HER)
 - based on projected energy savings
- For incomes <150% of AMI: Home Electrification & Appliance Rebate (HEAR)
 - based on measures
 - In metro Boston, 150% AMI = \$200K

States must submit plan to feds before funds can be released

Operating Costs

- Efficiency, temperature and fuel cost determine operating cost
- 70 - 80% spent above 32F
- Heat pump lose efficiency as temperature drops

10 Years of Heating Season Data

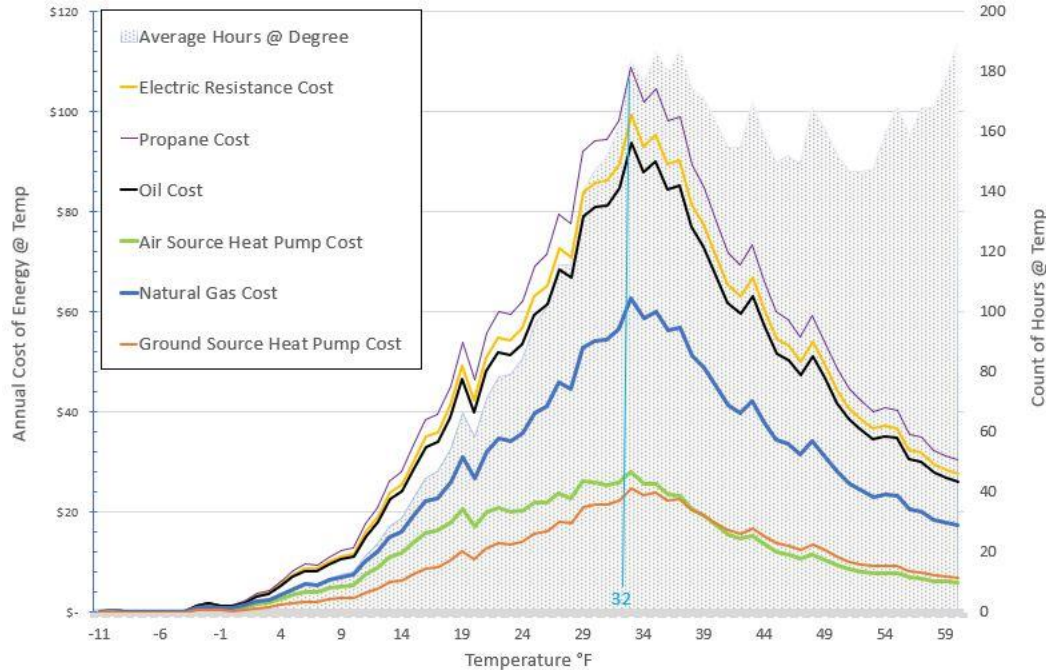


Operating Costs – with low electric rate

High gas prices last winter vs low aggregation rate

Having your own solar array would also lower your electric supply cost

Energy Cost Related to Temperature

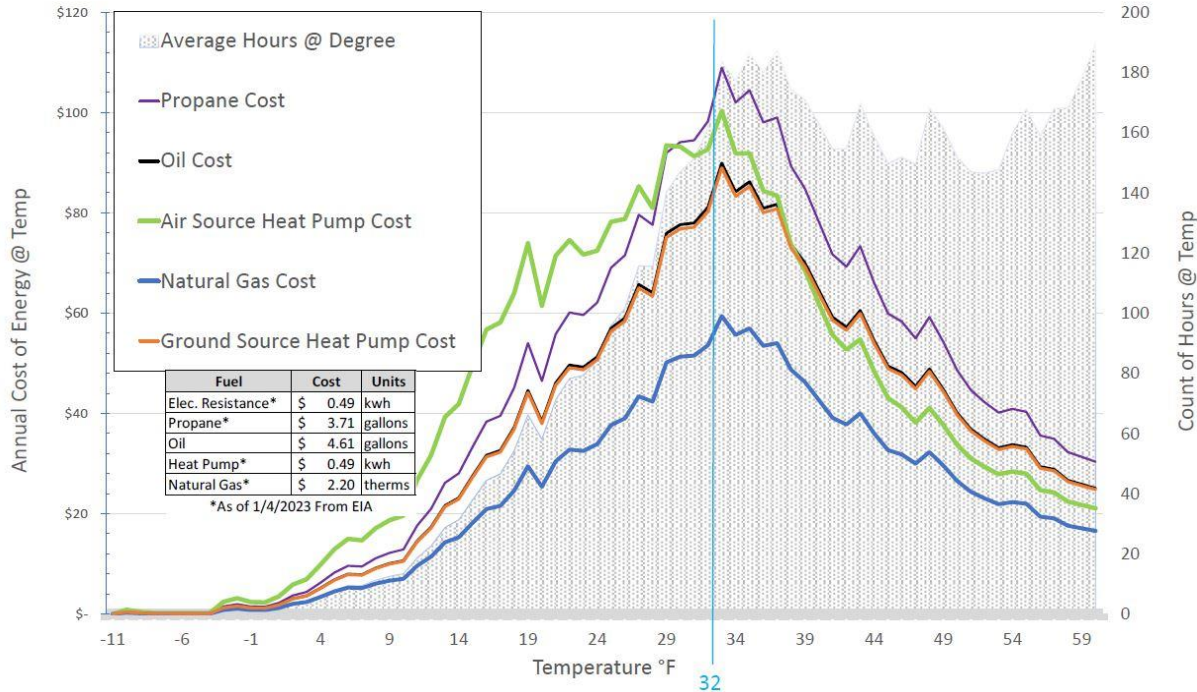


Fuel	Cost	Units
Elec. Resistance	\$ 0.14	kwh
Propane	\$ 3.71	gallons
Oil	\$ 4.81	gallons
Heat Pump	\$ 0.14	kwh
Natural Gas	\$ 2.32	therms

Temp °F	Heat Pump COP	
-15	1.95	
5	2.085	
17	2.22	
47	4.705	
60	4.705	

Operating Costs – with high electric rate

Energy Cost Related to Temperature



- High electric rates and low gas rates make heat pumps more expensive to operate.
- Utility company rates change every 6 months.

Heat pump system design options

When home has ductwork:

...Furnace instead of boiler

- Hot air ductwork allows for relatively easy replacement of fossil fuel system with whole home fully ducted heat pump.

...Central air conditioning

- Heat pumps can replace central a/c
 - One piece of equipment could replace two
- Ductwork must be in good condition

When home lacks ductwork:

Heat pumps don't produce hot enough water to easily replace boilers.

Ductless or mini-ducted systems

- Single head can serve a large open area
- Single zones or multi-zones
- Mini-ducted head to serve adjacent small rooms

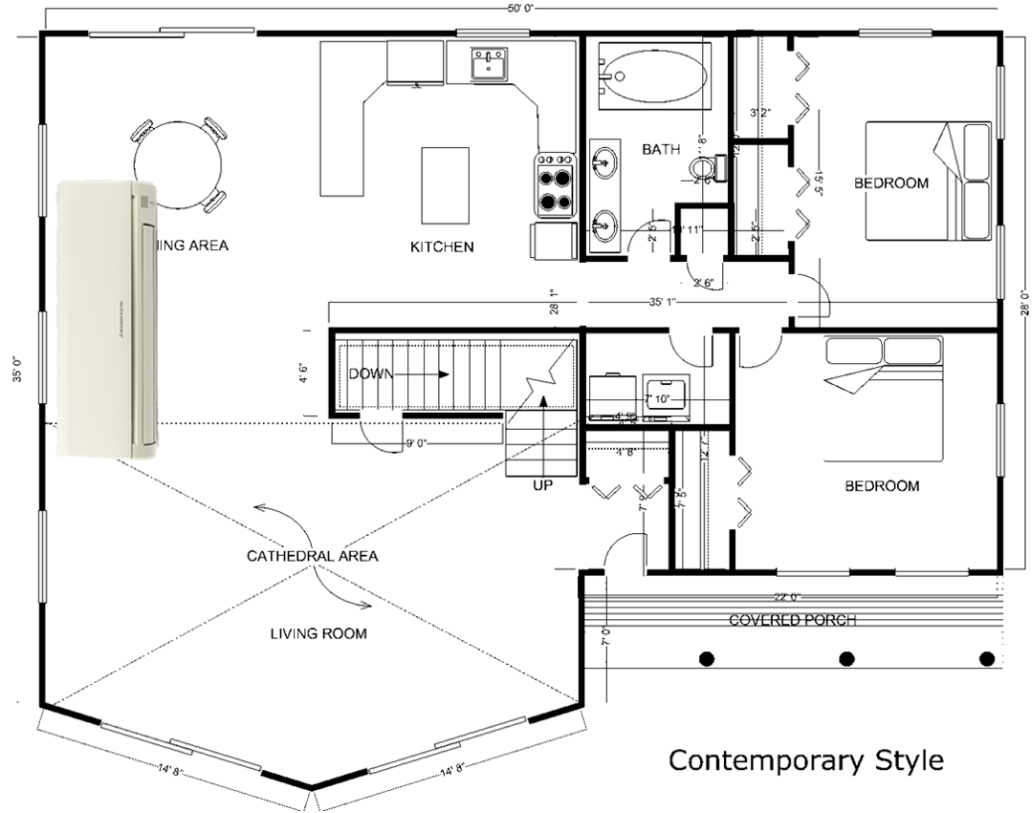
In all cases, you'll need space outside for condenser & snow protection



Sizing your system:

Example 24,000 BTU/h heat load

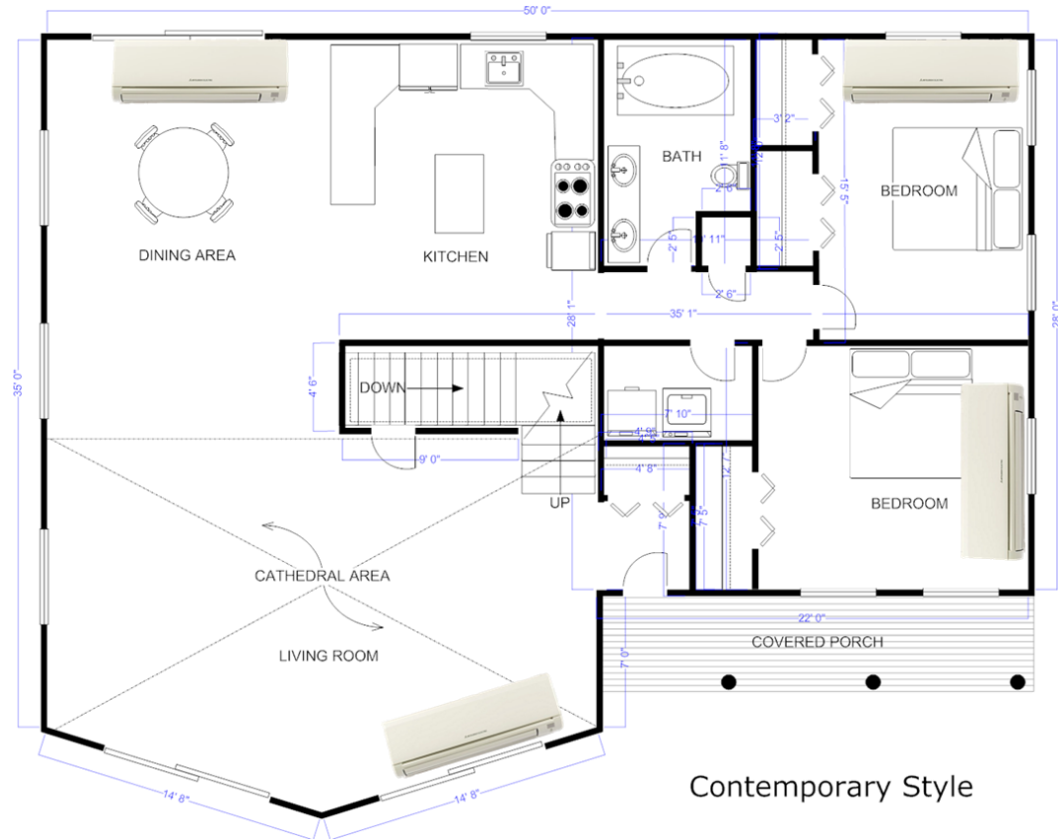
- One 24K head in living room
- Would provide enough heat and cooling but noticeable differential between rooms
- For partial displacement of fossil heat, move thermostat to hall or back bedroom and set lower than heat pump



Contemporary Style

Too many heads in too small a space

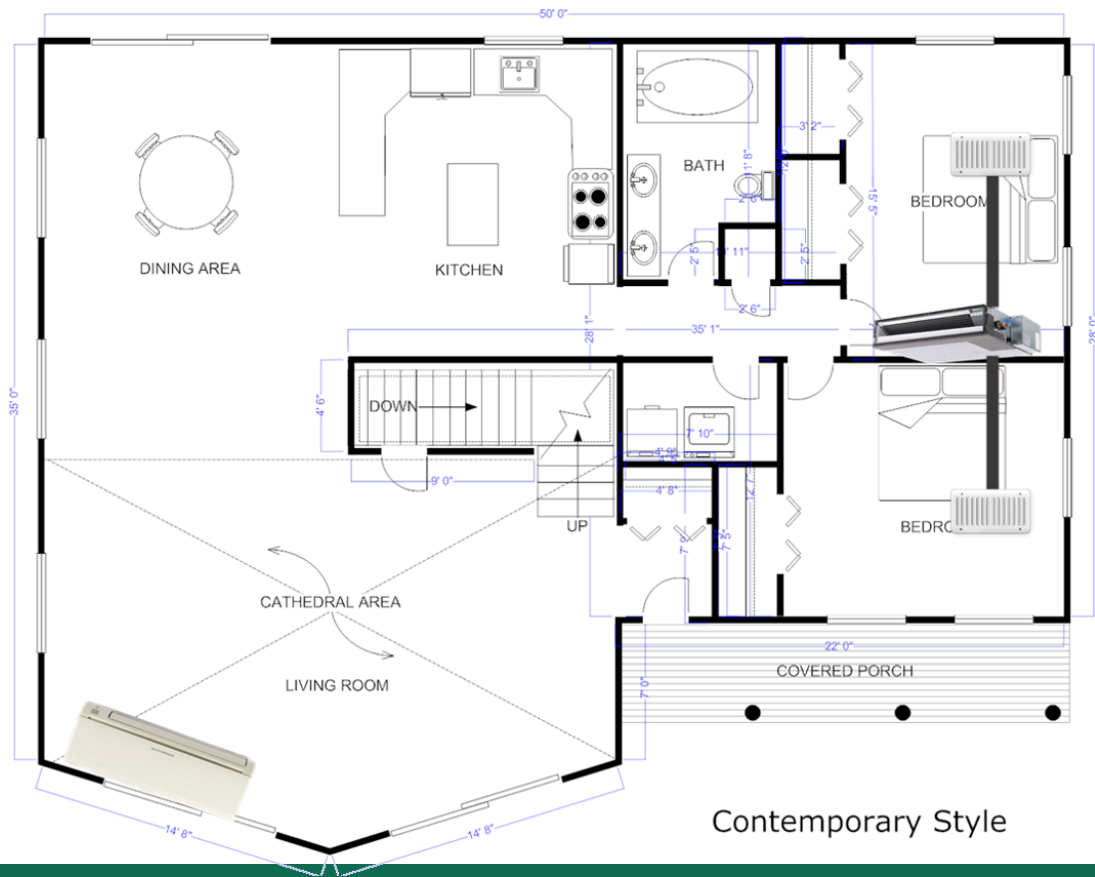
- Four 9K heads = 36K total (33% more than needed)
- Too much equipment will likely result in energy and performance issues.
- Heat pump systems are designed to run continuously
- On-off cycling is inefficient
- Cold and clammy in summer



Contemporary Style

Perfect mix: ductless and mini-ducted

- 12K Mini-ducted unit condition smaller rooms
- 12K in living room
- Could be connected to two condensers or only one
- Head can be up to 150 ft. from condenser



Contemporary Style

Next steps for heat pump research

- Virtual **independent** consultations
 - No-cost from Mass Save, Clean Heat RI, some munis
 - Heat Smart energy coaches
- Referrals to **trusted heat pump installers** (Eastern MA)
 - Elsewhere via utility programs and EnergySage
- Get 3 quotes

www.greenenergyconsumers.org/heatpumps

Closing and questions

If you liked this webinar...

- **Massachusetts Climate Policy Update**, Thursday, Feb. 29, noon
- **Electric Vehicles 101**, Tuesday, March 5, noon
- **Rhode Island Climate Policy Update**, Tuesday, March 5, 7:30pm
- Register: greenenergyconsumers.org/events
- Find our recorded webinars on YouTube: youtube.com/MassEnergy/1982

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Questions?

Loie Hayes

617-380-4741

loie@greenenergyconsumers.org



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