October 27th, 2022

HOW TO TALK TO YOUR CONTRACTOR AND YOUR NEIGHBOR ABOUT HEAT PUMPS

Midwest Building Decarbonization Coalition

Dan Wildenhaus – Sr Technical Manager

Decarbonization Training and Consulting Services

Center for Energy and Environment

Goals for today's webinar

- Introducing the Center for Energy and Environment
- Overview of the Inflation Reduction Act of 2022
- Level setting terminology, naming conventions, and application types
- Is my house ready for a heat pump?
- Am I ready for a heat pump?
- Is my contractor ready for a heat pump?
- Discussion time

Electrification and Decarbonization

Beneficial Electrification

- Must **reduce the amount of energy used**
- Must **be cost-effective**
- Must **not add to utility peak demand**
- Must **reduce greenhouse gas emissions**

Responsible Decarbonization

- **Includes Beneficial Electrification**
- **Good for the customer**
- **Good for the grid/utility**
- **Good for society**
- **Good for the supply chain and American jobs**

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Center for Energy and Environment

CEE's nonprofit mission

The Center for Energy and Environment promotes energy efficiency to strengthen the economy while improving the environment.

We provide practical energy solutions for homes, businesses, and communities.

WE STAND FOR

- ✓Collaboration
- ✓Expertise
- ✓Science
- ✓Community
- ✓Integrity
- ✓Equity

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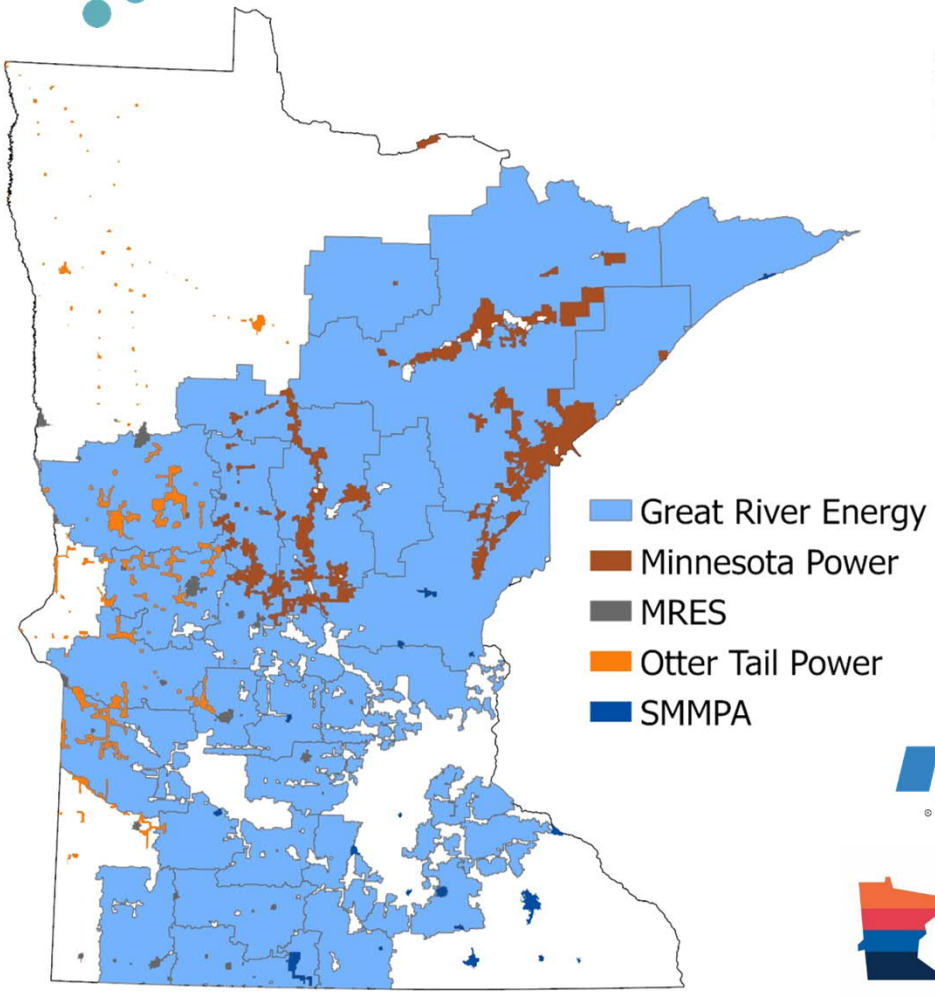
MN ASHP Collaborative



Started in 2019 to accelerate adoption of ASHPs in MN.

- High opportunity for delivered fuels and electric heat customers in rural MN.
- IOU, coop, and municipal utilities contribute funding.
- Following ECO bill, plan to expand to whole state and include dual fuel ASHPs in 2023.

minnesota power
Southern Minnesota Municipal Power Agency
OTTER TAIL POWER COMPANY
ASHP air source heat pump collaborative
MISSOURI RIVER ENERGY SERVICES
GREAT RIVER ENERGY
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Midwest ASHP Collaborative!

- Share and Promote ASHP Program Best Practices
- Develop and Implement a Regional Market Transformation Strategy
- Analysis and Convening to Optimize Electric Rate Structure

The IRA of 2022 will have three benefits for homeowners

1. Tax Credits
2. HOMES Rebates
3. High Efficiency Electric Home Rebates

- Total of 8.8 Billion Dollars invested in rebates
- Tax Credits run through 2032

https://www.rewiringamerica.org/app/ira-calculator

https://incentives-calculator.radiantlabs.co/

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25C Tax Credits

- For 2022
- Credit revived and made retroactive at original 10% of total installed cost
- Still has lifetime cap of $500
- $500 tax credit is available for homes built in 2022 tax year

- For 2023
- Credit increases to 30% of total installed costs through 2032
- Lifetime cap replaced with per measure cap of $600 and an annual cap of $1,200
- Exceptions that get unique tax credits
  - Heat Pumps and HPWHs - $2,000 credit
  - Energy Audits - $150 credit
  - Electric Panel Upgrades
  - EE HVAC (furnaces, boilers, central AC)

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Level Setting Terminology

ASHP

ASHP
air source heat pump collaborative

Heat pumps do not generate heat, they **move** it

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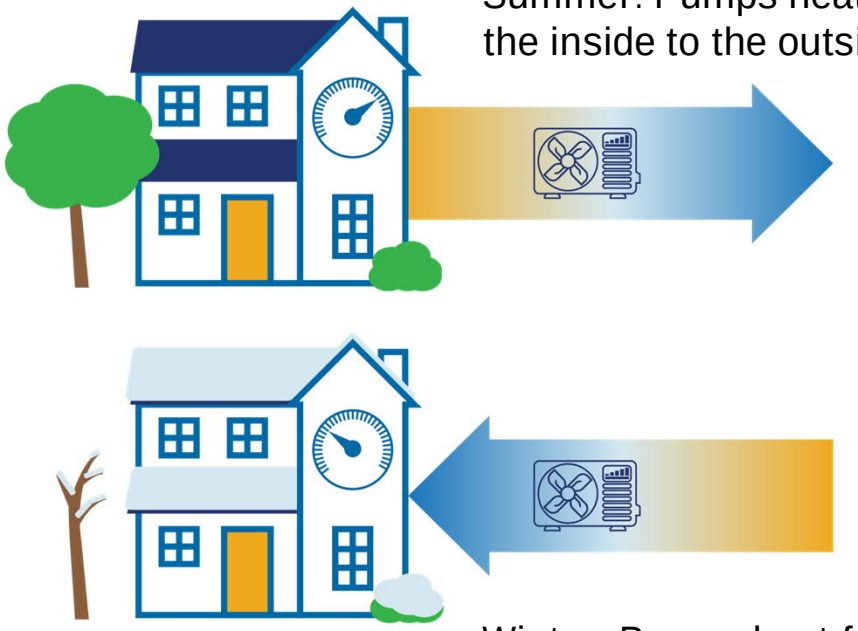
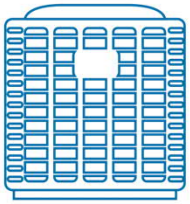
What is a heat pump?



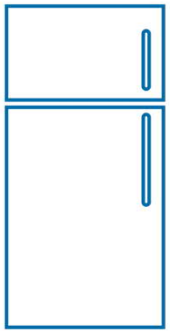
Summer: Pumps heat from the inside to the outside

Winter: Pumps heat from the outside to the inside

Same technology as:



Air Conditioner



Refrigerator

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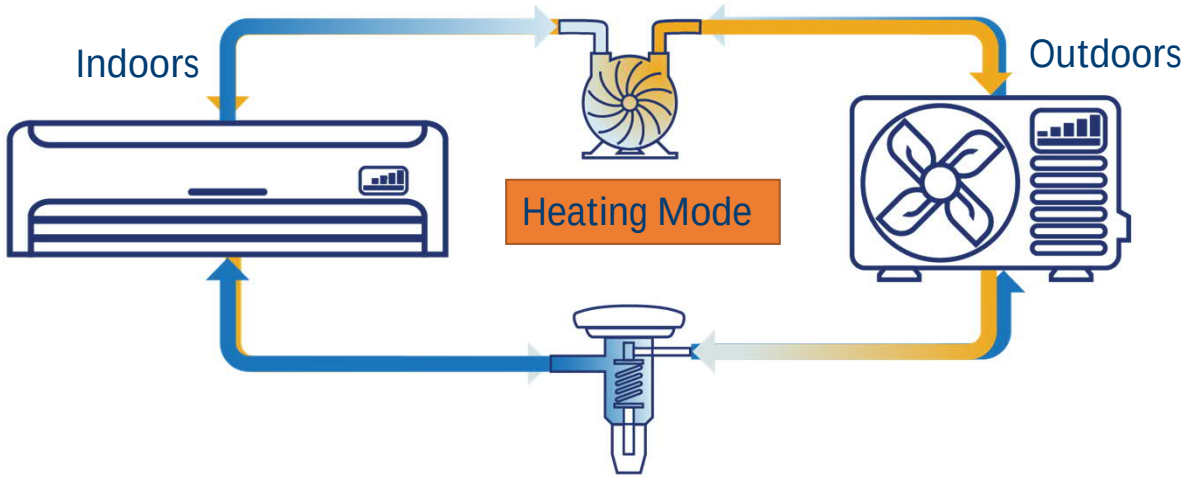
How do heat pumps work?

Vapor Compression Cycle

- Pumped refrigerant
- Pressurized (liquid) delivers heat
- Depressurized (gas) collects heat



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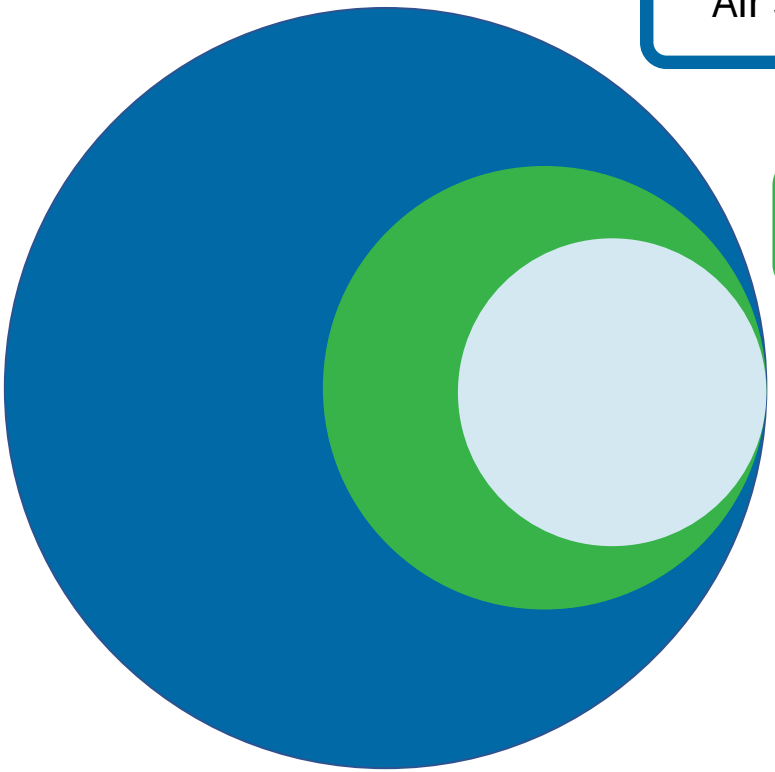
The many names of a heat pump



Air Source Heat Pump (ASHP)

Variable Speed Heat Pump (VSHP)

Cold Climate Air Source Heat Pump (ccASHP)

Also Known As:

- Inverter driven (for VSHP)
- Extended capacity
- Extra performance
- Extreme climate
- Various branded trade-names:
  Hyper heat®, Aurora ®, Halcyon XLTH ®, Max-Heat ®

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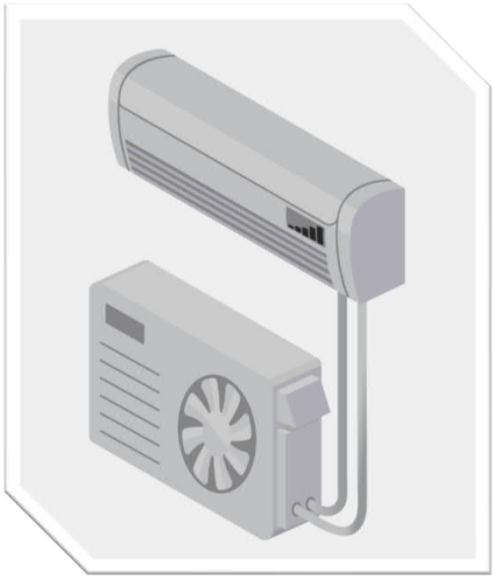
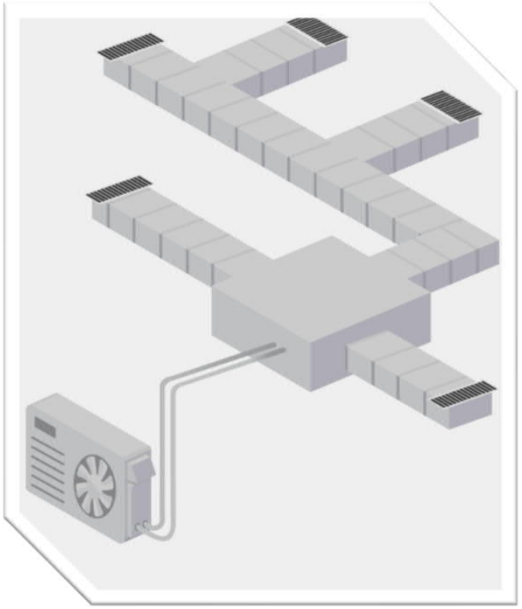
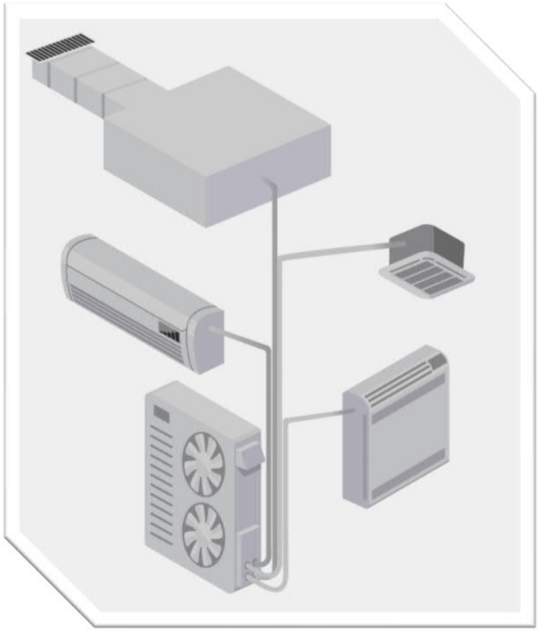
Heat Pump Designs



Mini-split



Ducted



Multi-split

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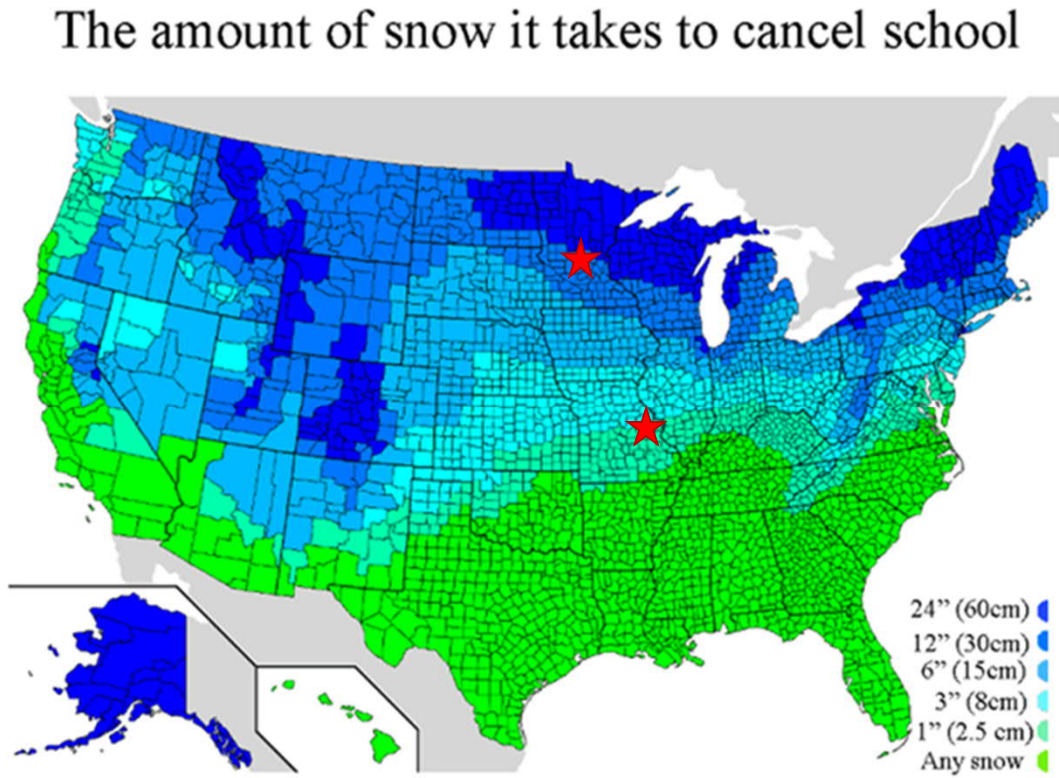
What is a cold climate? – Technical Answers

- Heating Degree Days
- Winter Design Temperature
- Heating Degree Days vs Cooling Degree Days
- Climate Zone Map



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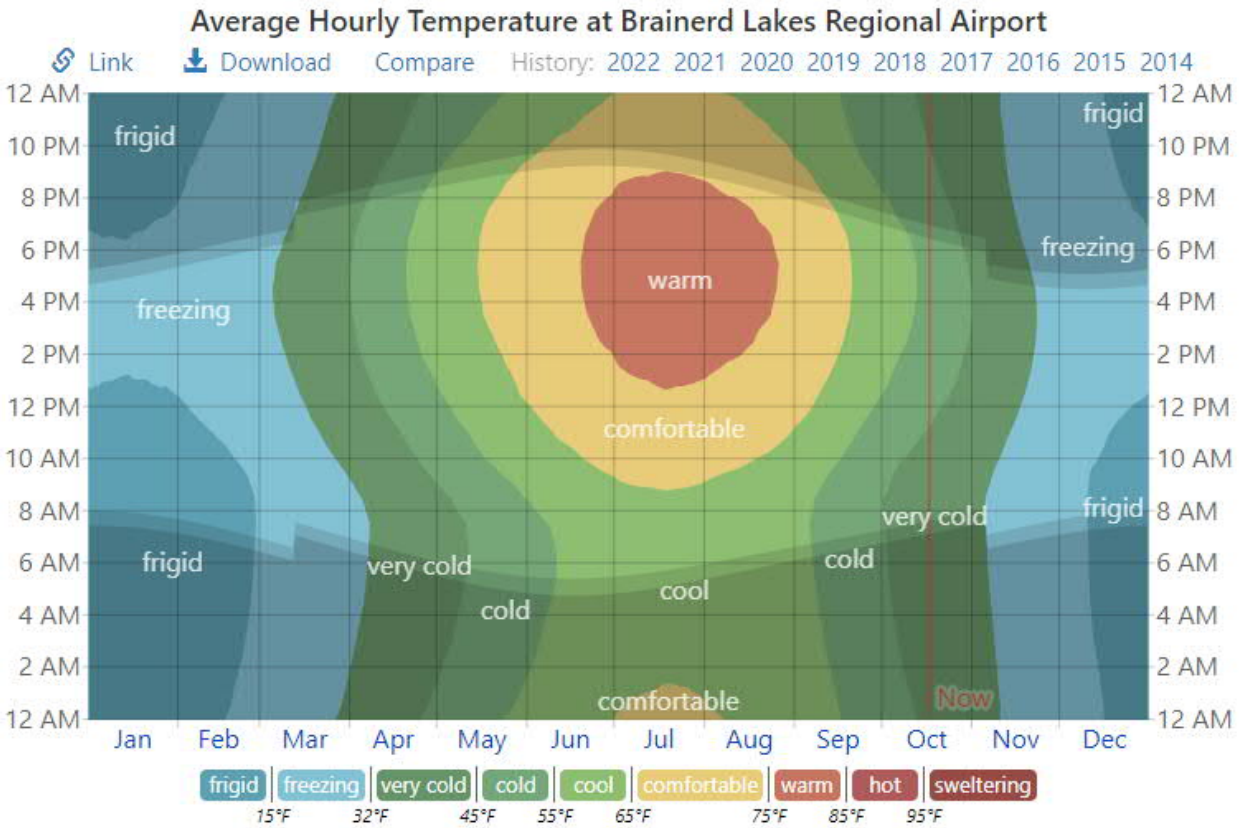
What is a cold climate? Visualizing



The average hourly temperature, color coded into bands. The shaded overlays indicate night and civil twilight.

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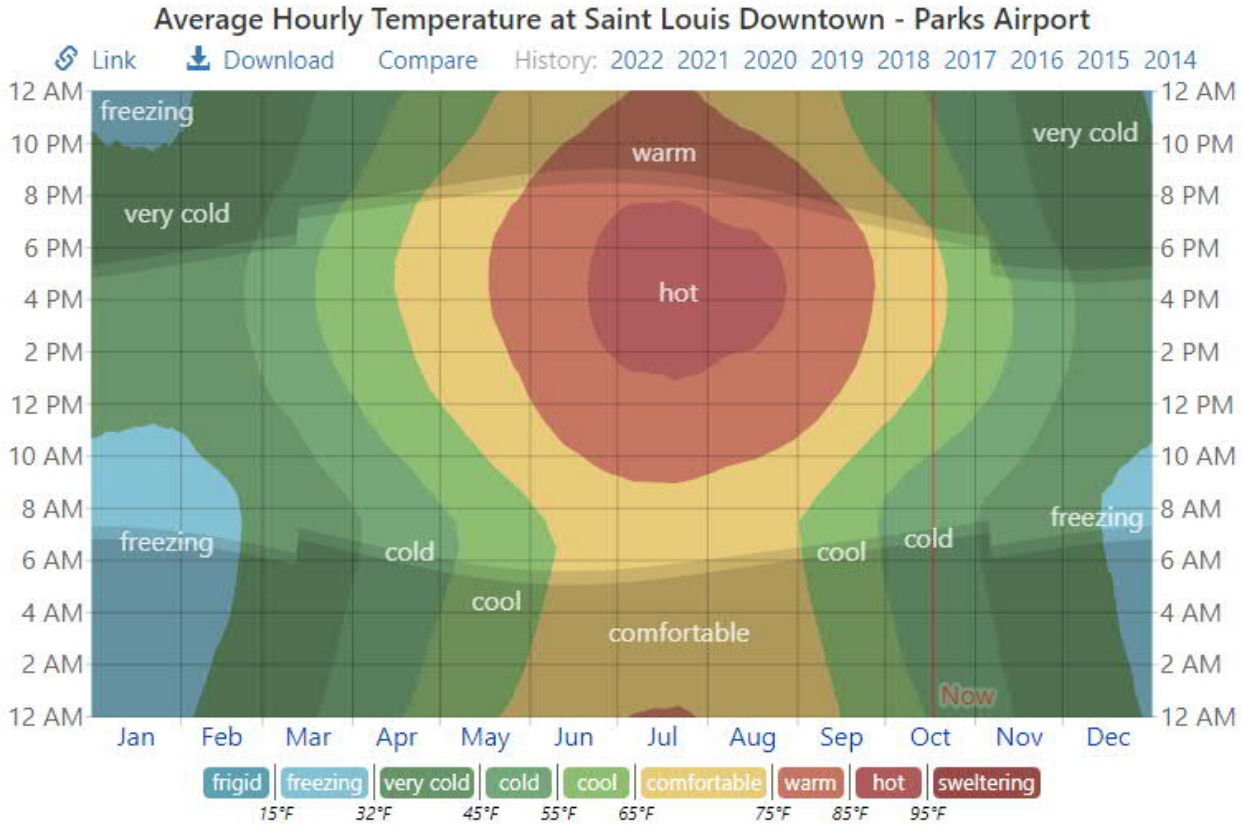
What is a cold climate? Visualizing



The average hourly temperature, color coded into bands. The shaded overlays indicate night and civil twilight.

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https://weatherspark.com/y/146353/Average-Weather-at-Saint-Louis-Downtown---Parks-Airport-Illinois-United-States-Year-Round

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What do we mean by “cold climate heat pump?”

- 1970s-1990s – Air source heat pumps were ~ 2x the efficiency of electric resistance heat and furnaces
  - Produced heat and cooling
  - Efficient and effective down to ~40ºF
- 2000s – Air source heat pumps and ductless heat pumps began using two speed and variable speed compressors and fans
  - Efficient and effective down to ~15ºF
  - More options in styles and sizes
  - ~3x the efficiency

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Cold Climate Heat Pump (ccASHP) Differences

- 2015 – Now - Cold Climate models arrive
  - Improve upon variable speed heat pumps
  - Produce heat down to at least 5ºF, in some cases tested down to -22ºF!
  - Produce warmer air temperatures at start up
  - Up to 3.5 or 4x the efficiency!

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Applications for Heat Pumps

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ASHP Application Types

Existing HVAC	ASHP Options	Considerations
AC replacement – with ductwork	Ducted ASHP	Sizing, energy costs, product cost, change over temperature
Cost Effective 30% - 50% energy savings		
Electric baseboard or radiant boiler	ccDHP	Sizing, home configuration, number of heads
Propane furnace	Ducted dual-fuel ccASHP	Sizing and change over temperature
Electric furnace	Ducted ccASHP	Sizing and electric plenum backup

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ASHP Application Types

Existing HVAC	ASHP Options	Considerations
AC replacement – with ductwork	Ducted ASHP	Sizing, energy costs, product cost, change over temperature
Big Opportunity!		
Electric baseboard or radiant boiler	ccDHP	Sizing, home configuration, number of heads
Propane furnace	Ducted dual-fuel ccASHP	Sizing and change over temperature
Electric furnace	Ducted ccASHP	Sizing and electric plenum backup

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1. Ducted, dual fuel or “hybrid” heat pump to displace furnace and replace AC

Benefits

- Ideal for AC replacement
- May extend the life of the furnace
- Resilience and future proof
- Homeowner education is an important

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2. Cold climate ductless heat pump for homes without ductwork

Benefits

- Improved comfort
- Some heating from the boiler can be supplemented with the heat pump
- Affordable way to add efficient heating and cooling without changing out existing heating system

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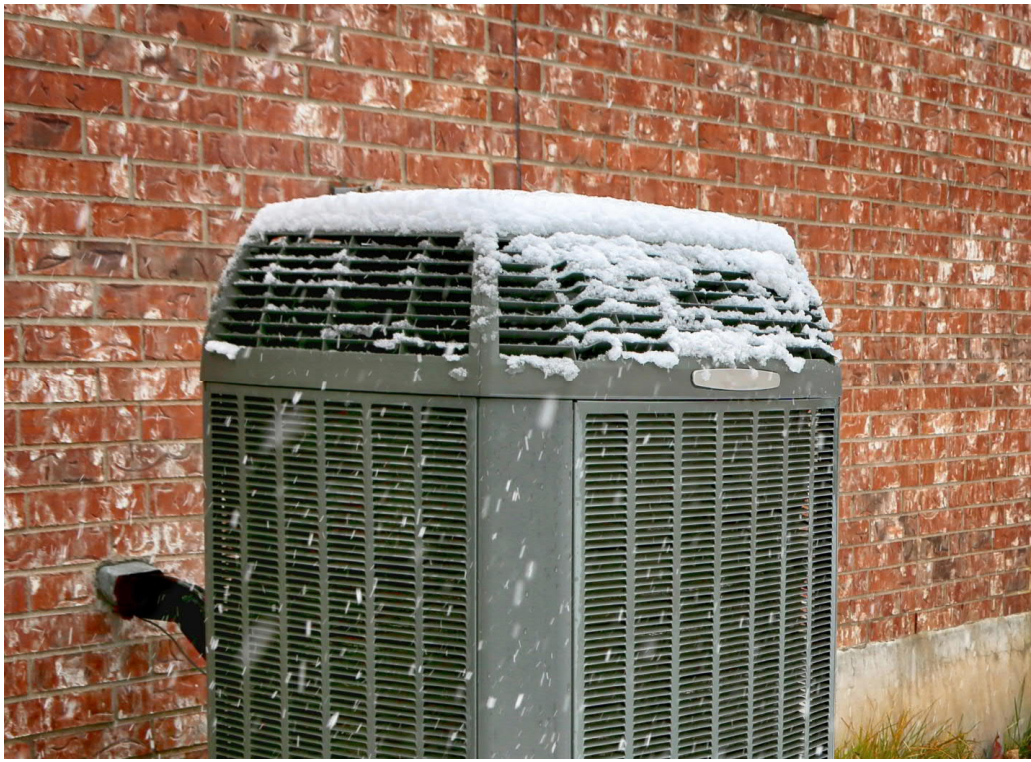
All electric cold-climate heat pump to replace furnace and AC

Benefits

- Both furnace and AC ready to replace
  - Ideal for high performance
  - Ready for propane and electric furnace or old heat pump homes
  - Ideal for poor functioning/older systems
- Reduced carbon impact
  - Pairs well with Solar PV
  - Pairs well with homes with batteries



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Is my home ready for a heat pump?

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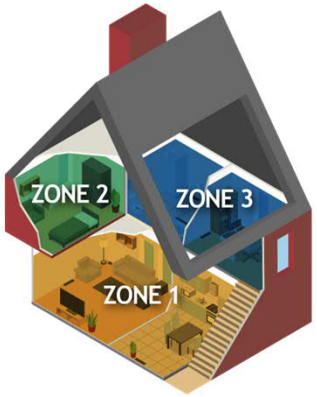
How is a heat pump sized and what matters?

The colder it is outside, the more heating energy needed to stay comfortable.

The heating load is judged based on the coldest days of the year.



- How much heat is needed?
  - In the home (block load)
  - In a zone (e.g., floor or wing)
  - In a room
- What goes into the calculation?
  - Design temperature (the regional climate)
  - Size of the home
  - Insulation – walls, ceilings, floors
  - Window quality and location
  - Building orientation

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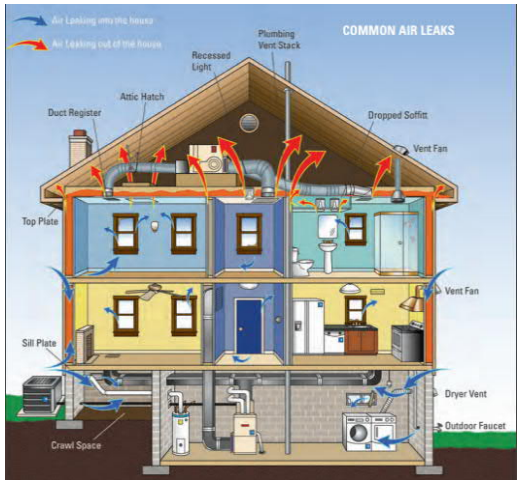
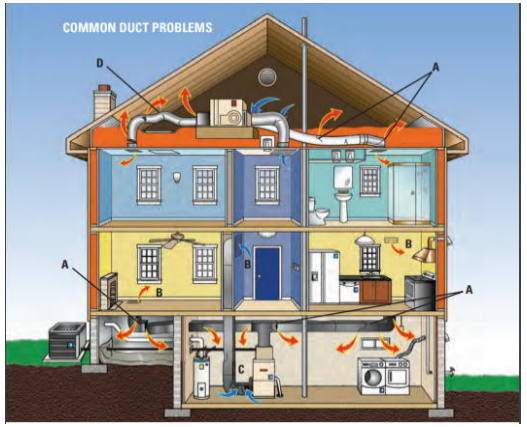
Weatherization for the win!

Weatherize first, *then* size for heating

- Keys to weatherization
  - Define the boundary of your conditioned space
  - Air seal
    - Top plates, joists
    - Recessed lights, duct boots
    - Penetrations
    - Weather stripping
    - Chimney dampers
    - Test with a blower door
  - Insulate
    - Attics, walls (if accessible)
    - Floors
    - Windows
- Size the heat pump *after* weatherization
  - Improved comfort
  - Smaller, less expensive heat pump
  - Reduces install challenges (ducting, indoor head locations)
  - Can make ductless applications more viable





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Is bigger better?

Average Midwest house heating system size

3.5 to 5 tons

Post weatherized homes

2 to 4 tons

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Other key ingredients

Old or undersized electric panels/wiring may not be ready for a heat pump

- Very old panels
- Homes with furnace and no central AC
- Homes with boilers
- Homes heated with woodstoves
- Old knob and tube wiring

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Am I ready for a heat pump?

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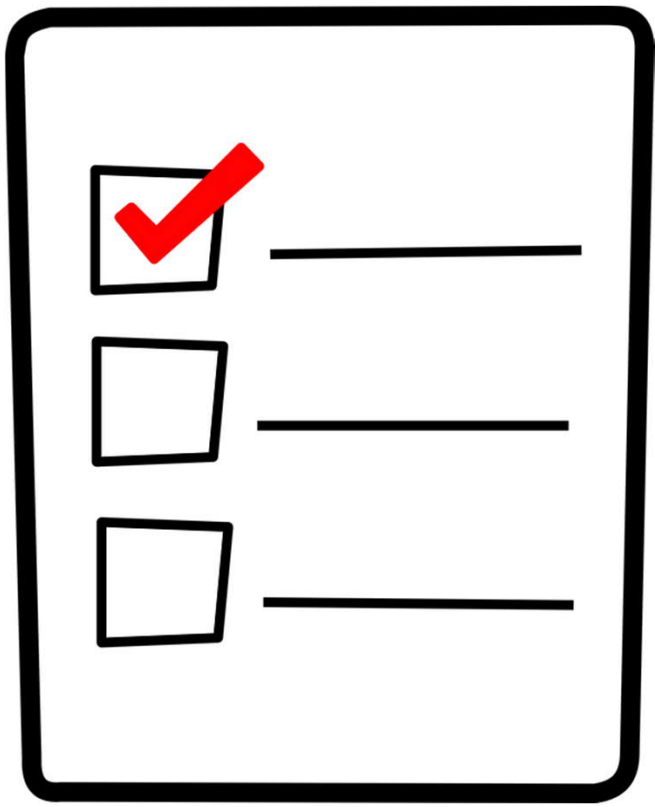
Getting to know heat pumps

- ❑ Attend this and other MWBDC webinars
- ❑ Know where to find additional resources
- ❑ Check your goals and the benefits of heat pumps for alignment
- ❑ Learn what to ask contractors about heat pumps
- ❑ Find out if your utility offers “dual fuel” or “all electric” rates
- ❑ Talk to your contractor about incentives, rebates, and tax credits



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Living with a heat pump

Furnace + AC

- Delivered air temp ranges from 115ºF to 130ºF (most of the time)
- Set back 3 to 6 degrees when away
- Check condensate line in winter (with 90% furnace)
- Change filter every 3 months

Heat Pump

- Delivered air temp ranges from 100ºF to 120ºF (most of the time)
- Set back 0 to 3 degrees when away (set it and forget it)
- Check condensate line in the summer
- Change filter every 3 months

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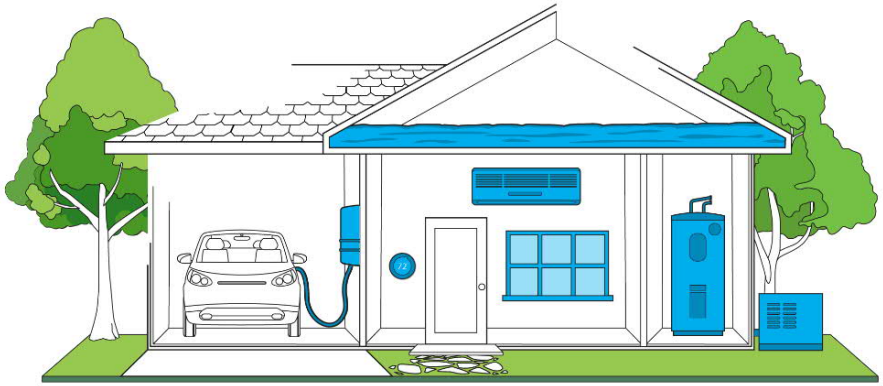
Homeowner resources

- MN ASHP Collaborative FAQ
- ENERGY STAR Home Upgrades
- NEEP ASHP Buyers Guide
- Clean Energy Resources Team ASHPs
- NYSERDA Heat Pump Buying Guide

ENERGY STAR HOME UPGRADE

The ENERGY STAR Home Upgrade is a carefully crafted set of six high-impact, energy efficiency improvements for your home. Designed to work together to deliver significant energy and cost savings, these upgrades can also help you transition from fossil fuels for a cleaner, healthier and more comfortable home. You can choose the improvements that make the most sense for your home and implement them at your own pace.

Our energy supply is getting cleaner and more renewable every day. Taking action now can help you prepare for a clean energy future, while enjoying energy savings and a more comfortable home today. Count on ENERGY STAR to help you navigate the process.



- CLEAN HEATING AND COOLING
- SUPER-EFFICIENT WATER HEATER
- SMART THERMOSTAT
- WELL-INSULATED AND SEALED ATTIC
- HIGH PERFORMING WINDOWS OR STORM WINDOWS

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Is my contractor ready to install a heat pump?

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Heat pump myths and misconceptions

- Almost all manufacturers have their own blog or resource on heat pump myths!
- There are several third-party sites with *mythbusting* heat pump posts and resources:
  - https://www.efficiencymaine.com/docs/Heat-Pump-Myths-and-Facts.pdf
  - https://www.ase.org/blog/myth-busting-common-misconceptions-about-heat-pumps
  - https://carbonswitch.com/do-heat-pumps-work-in-cold-weather/
- There are numerous case studies available for homeowners and contractors:
  - https://www.mnashp.org/guides
  - https://concordma.gov/2776/Heat-Pump-Case-Studies
  - https://sustainabletechnologies.ca/app/uploads/2022/03/HP_Case_Study_4_Final.pdf

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Is your contractor trained?

All contractors likely have some formal training and many years of on-the-job training!

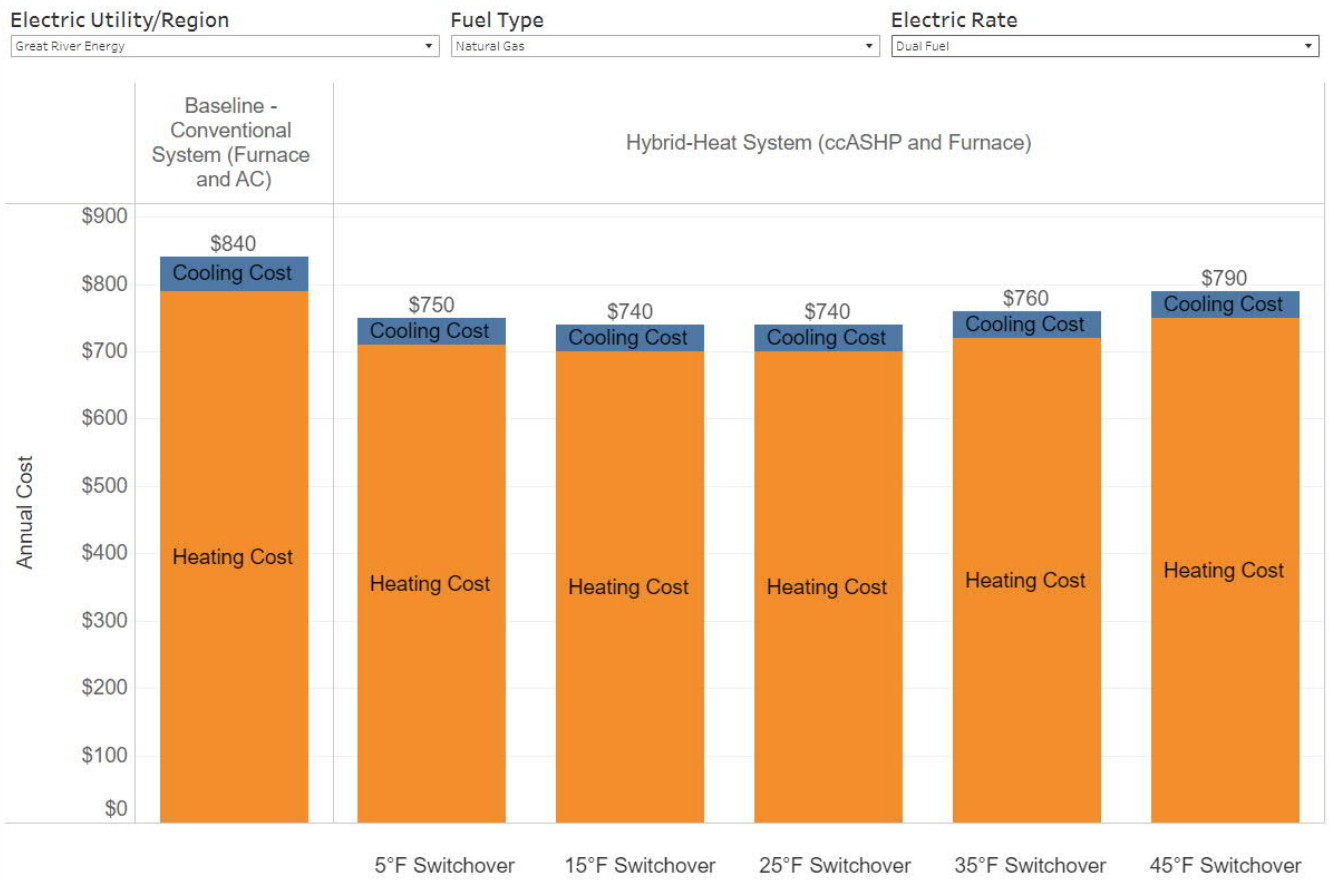
Ask if they have had training on:

Manufacturer training on cold climate and dual fuel or “hybrid” heat pumps	Heat pump controls, hybrid system controls, and homeowner guidance on settings	Sizing and selection of variable speed heat pumps

Finding a contractor

- MN ASHP Collab - How to choose a contractor
- Love Electric - Tips for Planning Your Installation
- Energy Sage - 8 Questions to ask your contractor
- Look for a Preferred Contractor Network!
- Use Buyers Guides!

Cost of Heat Tool for Minnesotans



https://www.mnashp.org/cost-of-heat-comparison

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Additional cost of heat tools

efficiency MAINE

866-376-2463 | Contact

AT HOME AT WORK ENERGY INFORMATION RESOURCES ABOUT

Compare Home Heating Costs

Use this tool to estimate what your annual heating costs would be using different heating systems.

1. Find the row that best describes your home's heating system configuration
2. Update fuel cost and other relevant assumptions (efficiency rating is under "show details")
3. Press Increase/Decrease until Annual Cost matches yours

Increase | Decrease | Reset | Calculate

Fuel Type (Units)	Cost per Unit Delivered	Heating System	Show Details	Annual Cost
Firewood (cord)	$300	Wood Stove	☐	$ 1,276
Electric (kWh)	$0.21	Geothermal Heat Pump	☐	$ 1,534
Electric (kWh)	$0.21	Heat Pump	☐	$ 1,675
Natural Gas (therm)	$1.92	Natural Gas Room Heater	☐	$ 1,845
Wood pellets (ton)	$312	Pellet Stove	☐	$ 1,993
Natural Gas (therm)	$1.92	Natural Gas Boiler	☐	$ 2,126
Wood pellets (ton)	$312	Pellet Boiler	☐	$ 2,287

mass save

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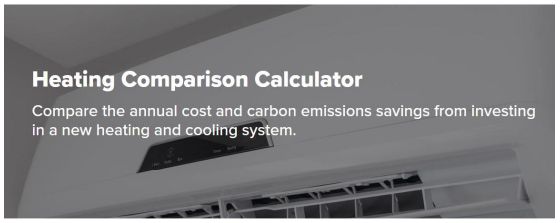

If you're considering an upgrade to your current heating and cooling equipment, use the Mass Save® Heating Comparison Calculator (HCC) to see how installing a high-efficiency heating system could impact your heating costs—and how much it could reduce your carbon emissions.

Before upgrading your heating system, consider preliminary measures such as sealing and insulating your ductwork and completing weatherization work. Ensuring your home has adequate insulation levels prior to upgrading your heating system can save you up to 20% on your heating and cooling costs and improve the comfort of your home year-round. Click here for more information.

SAVINGS CALCULATOR

SEE HOW MUCH YOU CAN SAVE WITH ENERGY STAR

The average household spends more than $2,200 a year on energy bills, with nearly half going to heating and cooling. HVAC equipment that earns the ENERGY STAR label is independently certified to save energy, save money and help protect the climate.

What type of heating and/or cooling system do you have in your home?

- (●) Central cooling and/or heating delivered through duct work and air vents (i.e. forced air)

What type of heating and/or cooling system do you have in your home?

- ( ) Central air conditioning only
- (●) Central air conditioning and heating delivered through duct work and air vents (i.e. forced air) using a heat pump

Split system or single package?

- (●) Split System
- ( ) Single Package

Enter your zip code?

What is the current size (in tons or BTUs) of your existing system?

12,000 BTUs - 1 ton

If you are unsure, what is the square footage of the space you are heating/cooling?

When was your existing system installed?

2019

New Hampshire Electric Co-op

MY ACCOUNT OUTAGES & SAFETY SAVE ENERGY MY CO-OP

Compare & Calculate Your Savings

For climates with moderate heating and cooling needs, heat pumps offer an energy-efficient alternative to furnaces and air conditioners. Like your refrigerator, heat pumps use electricity to move heat from a cool space to a warm space, making the cool space cooler and the warm space warmer. During the heating season, heat pumps move heat from the cool outdoors into your warm house and during the cooling season, heat pumps move heat from your cool house into the warm outdoors. Because they move heat rather than generate heat, heat pumps can provide equivalent space conditioning at as little as one quarter of the cost of operating conventional heating or cooling appliances.

Compare the Savings Between Your Fuel Source & Heat Pumps

Heat Pumps are one of the most cost-effective methods to heat your home. See the chart below for a comparison of how your fuel type compares to Air Source Heat Pumps.

Fuel type	Price Unit	Heat Content Per Unit (BTU)	System efficiency	Price Per million BTU
Fuel Oil (#2)	$4.82/gallon	138,500	80%	$23.38
Propane	$3.79/gallon	91,333	80%	$43.04
Kerosene	$5.71/gallon	135,000	80%	$29.34
Electricity-Resistance Heat	$0.2883/kWh	3,412	100%	$48.52
Electricity-Air Source Heat Pump	$0.29/kWh	3,412	250%	$19.41
Wood Pellets (Bulk Delivered ton)	$335.34	16,500,000	80%	$23.64

CleanEnergy States Alliance

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CESA > Projects > Building Decarbonization and Clean Heating/Cooling > Clean Heating and Cooling (CH&C) Calculator > Connecticut Clean Heating and Cooling (CH&C) Calculator

Connecticut Clean Heating and Cooling (CH&C) Calculator

This easy-to-use tool allows you to calculate your annual carbon savings and potential savings from switching to a Clean Heating & Cooling technology.

Use the tool below to estimate the greenhouse gas emissions savings and potential cost savings from switching all or a portion of your home's heat from fuel oil, propane, natural gas, or electric baseboard to a Clean Heating and Cooling solution. You can choose from a variety of Clean Heating and Cooling technologies: the tool covers air source heat pumps, ground-source heat pumps (sometimes called geothermal heat pumps), solar hot water, and heat pump water heaters.

The tool includes links for more information on these technologies and heat-distribution systems. We recommend that you visit Energize CT's Clean Heating and Cooling page to learn more about each of the technologies covered by this tool.

The tool provides an estimated range of savings based on your inputs and current energy rates in Connecticut. To get the most accurate estimate, you may want to have a recent electricity bill and recent fuel bill in hand. The tool provides both cost and emissions savings as an estimated range, because many variables can affect your actual savings, such as the extent of your home's insulation, the efficiency of your existing heating system, the current cost of fuel, the layout of your home, and the severity of the winter.

For guidance on Clean Heating and Cooling solutions in Connecticut, please visit Energize CT's Clean Heating and Cooling page.

- Tool results +
- Incentive Details +
- How to use your summary report +
- Legal disclaimer +

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CEE's field research results

✓Significant savings for replacing propane and electric resistance

Percentage Reductions for ccASHPs				
	Site energy	**Source energy**	**Homeowner cost**	**Emissions**
Dual-fuel ASHP vs. propane furnace	40%	10%	30%	5%
All-electric ducted & ductless HP vs. electric resistance	55%	55%	55%	55%

✓Technology continues to improve

- New generation systems can operate as low as -22° (efficiently as low as -13)

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A Summary of ASHP Benefits

- Improved comfort*
- Resiliency against price volatility
- Operational cost savings for certain application types
- Increased energy efficiency
- Decrease furnace short cycling during shoulder months
- Reduce carbon footprint

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*Potentially – dependent on right sizing, proper controls, and homeowner education

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Discussion time!

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Thank You!

Dan Wildenhaus
Sr Technical Manager
Decarbonization Training and Consulting Services

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