

# Efficiency Maine Heat Pump Basics Module

As of January 2024



Welcome to the Efficiency Maine Heat Pump Basics Module.

# Agenda

## 1. Introduction

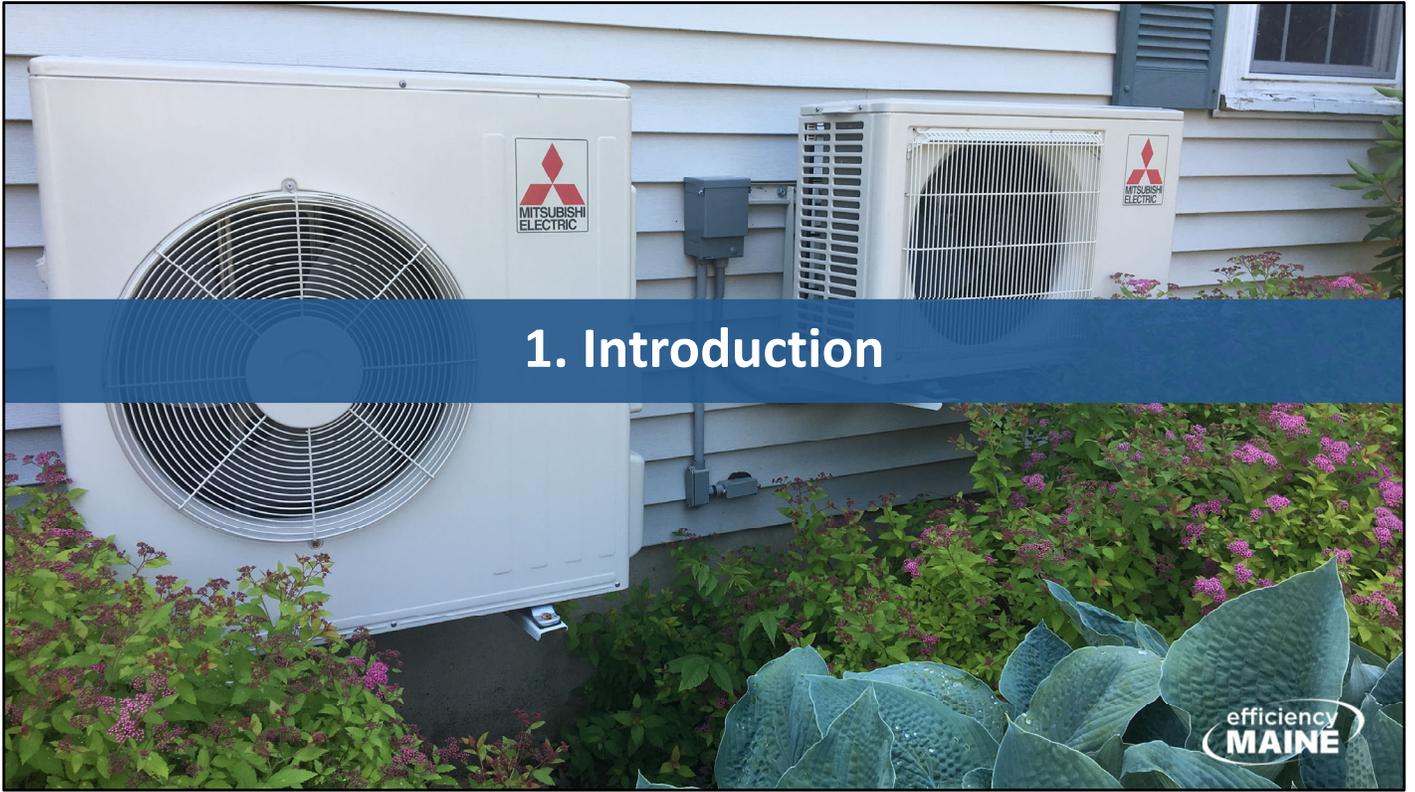
2. Rebates and Loans
3. Becoming a Residential Registered Vendor or Commercial Qualified Partner
4. Heat Pump Myths and Facts
5. Selection
6. Sizing
7. Placement
8. Installation
9. Operation
10. Other Considerations



This module is divided into 10 sections. You need not complete all sections at once - simply come back to the training module and pick up where you left off. However, if you leave in the middle of a section, when you return you'll have to start that section over so it's best to take breaks ***after*** you click on the "next lesson" button at the end of a section.

This training will cover an introduction of Efficiency Maine, including rebates and loans, and we'll explain becoming a registered residential vendor or a commercial qualified partner.

Next we'll address heat pump myths and facts, selection, sizing, placement, installation, operation, and some ***other*** heat pump considerations.



The first section is an introduction to Efficiency Maine.

## About Efficiency Maine

- Efficiency Maine offers rebates, loans, brochures and marketing support designed to motivate customers to call our Residential Registered Vendors.
- Restrictions on our funding require that all rebated installations are cost-effective.
- Cost-effectiveness of heat pumps depends on proper placement, sizing, selection, installation, and user training.



1. Introduction - 1

Efficiency Maine offers rebates, loans, brochures and marketing support designed to motivate customers to call our Residential Registered Vendors.

Restrictions on our funding require that all rebated installations are cost-effective. Unlike an LED bulb or ENERGY STAR clothes washer, the cost-effectiveness of a **heat pump** depends a lot on its placement, sizing, selection, installation, and use.

# Transition to Efficient Heating and Cooling Systems

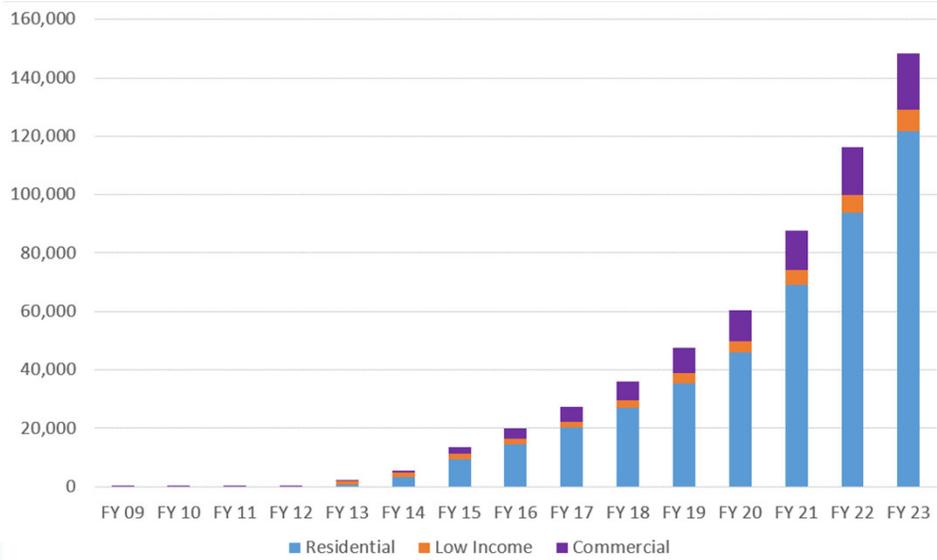
- State Goal:
  - Install at least 320,000 heat pumps by 2027.
- Objectives:
  - Lower heating bills
  - Achieve carbon reductions and displace heating oil
  - Grow the Maine economy by lowering the cost of heating and adding jobs to sell and install heat pumps
  - Benefit all sectors, all income levels, and all geographic areas of the state.



1. Introduction - 2

Heating, cooling, and lighting of buildings are responsible for almost one-third of Maine's greenhouse gas emissions. The Governor has set a target to install 320,000 heat pumps by 2027.

# Cumulative Heat Pump Installations



This graph shows the popularity of heat pumps in Maine. We have issued more than 100,000 heat pump rebates for homes and businesses.

## About This Video

- Efficiency Maine inspects thousands of heat pump installations done by hundreds of installers each year.
- This video is intended to share best practices.
- This video is ***not*** intended to replace industry training.



1. Introduction - 4

Efficiency Maine inspects thousands of heat pump installations each year and observes the very best practices.

This video is intended to ***share*** those best practices.

We plan to update it on an ongoing basis to make sure all Residential Registered Vendors receive the benefit of what we learn.

However, this video is ***not*** intended to replace industry training or what installers learn from working alongside more experienced peers.

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This is the end of the introduction. To move ahead to the next section on Rebates and Loans, click the “Next Lesson” button below this video window.



This section will cover Efficiency Maine rebates and loans.

## Heat Pump Rebates

Income Bracket	Efficiency Maine Rebate	Federal Tax Credit	Total
<b>Low Income</b> (MaineCare, TANF, SNAP, HEAP)	80% of cost up to <b>\$8,000</b> rebate	30% of cost up to <b>\$2,600</b>	<b>\$10,600</b>
<b>Moderate Income</b> (AGI <\$70k/yr single, \$100k/yr jointly)	60% of cost up to <b>\$6,000</b> rebate	30% of cost up to <b>\$2,600</b>	<b>\$8,600</b>
<b>Any Income</b>	40% of cost up to <b>\$4,000</b> rebate	30% of cost up to <b>\$2,600</b>	<b>\$6,600</b>

See website for information on commercial rebates.



2. Rebates and Loans - 1

Heating, cooling, and lighting of buildings are responsible for almost one-third of Maine's greenhouse gas emissions. The Governor has set a target to install 320,000 heat pumps by 2027.

## Residential Heat Pump Loans

- Up to \$7,500
- Up to 10-year terms
- Connect your customers:
  - [Efficiency Maine Loans webpage](#)
  - Free Efficiency Maine [home energy loan brochure](#)
  - Register for loan portal ID and password by calling 866-376-2463
  - Only available to Residential Registered Vendors



2. Rebates and Loans - 2

In addition to rebates, we have residential heat pump **loans**.

Income-eligible customers can borrow up to \$7,500 with competitive terms.

Residential Registered Vendors interested in offering Efficiency Maine loans to their customers can contact us to get their own loan-website login-ID and password.

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This completes the section on rebates and loans. Click the “Next Lesson” button to advance to the section on “Becoming a Residential Registered Vendor or Commercial Qualified Partner.”



### 3. Becoming a Residential Registered Vendor or Commercial Qualified Partner

Section 3 covers Becoming a Residential Registered Vendor or Commercial Qualified Partner under Efficiency Maine's programs.

## Residential Registered Vendor Benefits

### Benefits

1. **Free leads** - Our online installer locator receives over 40,000 searches each year.
2. **Rebates** - Eligible upgrades qualify for generous rebates that make them more affordable.
3. **Financing** - We offer easy home energy financing with competitive terms for rebated work.
4. **Marketing funds** - We reimburse heat pump and insulation installers 50% of eligible marketing expenses up to \$5,000 per year.
5. **Training scholarships** - We reimburse heat pump and insulation installers 50% of course/exam costs up to \$500 per employee.
6. **Sales tools**
  - a. We provide our Efficiency Maine Residential Registered Vendor logo for websites, vehicle wraps, signs, etc.
  - b. We mail printed copies of brochures at no charge.
7. **Monthly newsletters** - We publish monthly e-newsletters featuring program updates, tips from our quality assurance inspectors, and upcoming exhibiting opportunities.
8. **Support from Efficiency Maine** - We have a team dedicated to helping you take advantage of our offerings.



3. Becoming a RRV or QP - 1

Some of the benefits of being a Residential Registered Vendor — also referred to as an RRV — are access to rebates and loans as tools for selling upgrades, as well as exposure on our website’s Vendor Locator, free brochures, and a monthly program update email-newsletter. There is no fee to register.

To give you an idea of how our marketing can benefit you, in a typical year, Efficiency Maine runs ads in newspapers and magazines, and on Google, Facebook, and radio that reach millions of readers and listeners statewide. Our website receives more than 200,000 in-state visits per year and 40,000 searches on our Vendor Locator tool.

# Residential Registered Vendor Requirements

## Requirements

- Participation Agreement / Code of Conduct
- General Liability Insurance
- Workers' Compensation Insurance
- One member of each heat pump installation crew will need:
  - EPA Section 608 Certification.
  - Heat pump installer training provided by a manufacturer of ENERGY STAR® heat pumps, or an Efficiency Maine Registered Trainer.
  - The certificate from this one-hour, free Efficiency Maine Annual Heat Pump Basics training video.



3. Becoming a RRV or QP - 2

Efficiency Maine requires RRVs to sign the Efficiency Maine Residential Registered Vendor Agreement Form, and have general liability and workers' compensation insurance.

In addition, there are three heat-pump-specific requirements. One member of each heat pump installation crew must have:

- [EPA Section 608 Certification](#).
- Heat pump installer training provided by a manufacturer of ENERGY STAR® heat pumps, or an [Efficiency Maine Registered Trainer](#).
- The certificate from this one-hour, free [Efficiency Maine Heat Pump Basics](#) training video.

## Commercial Qualified Partner

### Benefits

- Technical information and advice
- Sales calls between Qualified Partners and Efficiency Maine field personnel
- Online application submittal
- Promotional materials
- Limited co-op advertising assistance
- Free or discounted access to all Efficiency Maine training programs
- Direct access to Program Delivery Team for technical information and project enrollment support
- Access to exclusive Efficiency Maine Qualified Partner website

### Requirements

- Signed Qualified Partner Terms and Conditions
- Completion of Training Webinars
- Proof of Insurance
- US EPA Section 608 Refrigerant Handling Certificate (Type 2 or Universal)
- State of Maine Master Electrician License



3. Becoming a RRV or QP - 3

The benefits of becoming a Commercial Qualified Partner are similar and will allow you to access heat pump rebates for your ***commercial*** customers. The requirements for becoming a Qualified Partner are outlined here. You can register to become a Qualified Partner or Residential Registered Vendor -- or both -- on the Efficiency Maine website.

# Residential Registered Vendor and Qualified Partner Locator Tools

What services do you need?  ZIP Code:  Distance:  Sort by:

**Use our search feature to find a vendor near you.**

\* Ranked according to the quantity of projects that received a rebate from Efficiency Maine over the past four months.

Find a Residential Registered Vendor

Use this tool to find an Energy Advisor, Contractor, or Renewable Energy Installer near you.

What services do you need?  ZIP Code:  Distance:  Sort by:

Vendor	Energy Assessment & Air Sealing	Heat Pumps	Heat Exchangers	On-site Construction / Heating	Photovoltaic Systems	Geothermal Systems	Heat Pump Water Heaters	Pool	Phone	Web/Email	
1. <b>Royal River Heat Pumps LLC</b> 355 US Rt. E, Freeport, ME - 04932	•	•							207-400-4065	<a href="#">Visit Website</a> <a href="#">Send an Email</a>	40 Miles
2. <b>Hometown Heat Pumps Inc</b> 355 South Horrocks Rd, Burnham, ME - 04922	•	•							207-416-7629	<a href="#">Visit Website</a> <a href="#">Send an Email</a>	28 Miles
3. <b>Dave's Appliance Inc</b> 59 Central St, Winthrop, ME - 04564	•								207-377-8858	<a href="#">Visit Website</a> <a href="#">Send an Email</a>	13 Miles
4. <b>Northeast Heat Pumps</b> 72 South Rd Durham, ME - 04222	•								207-504-0128	<a href="#">Visit Website</a> <a href="#">Send an Email</a>	35 Miles



3. Becoming a RRV or QP - 4

To help customers find Residential Registered Vendors and commercial Qualified Partners we have locator tools on our website. Over 40,000 visitors use our vendor locator search tool each year.

# Free Heat Pump Sales Tools

## Brochures

- Introduction to Heat Pumps brochure
- Heat Pump Rebate brochure
- Heat Pump User Tips
- Quick Guide to Home Heating brochure

## Website

- Cost of Home Heating calculator and table
- Heat Pump Installation Considerations
- Frequently Asked Questions
- Heat Pump User Tips webpage and video



3. Becoming a RRV or QP - 5

To help you with marketing, Efficiency Maine has several free heat pump brochures, including an overview of heat pump technology, information about rebates, and heat pump user tips.

Efficiency Maine also offers a “Quick Guide to Home Heating” brochure that helps customers compare the annual cost of heating with a heat pump to other heating systems.

You can download these from our website or if you’d like free, professionally printed copies, you can order them online or call our Call Center at 866-376-2463.

# Residential Installation Requirements Checklist

- Must be followed on every installation.
- In this presentation, requirements are indicated as follows:

★ Efficiency Maine Installation Requirements Checklist

RESIDENTIAL HEAT PUMP Installation Requirements Checklist		efficiency MAINE	
Customer Name:			
Street Address:			
This form does not need to be submitted, but all items are required for rebate eligibility.			
<b>Outdoor Unit</b>			
<input type="checkbox"/>	1' above any surface where snow will accumulate		
<input type="checkbox"/>	Water from defrost will not form ice on walkway		
<input type="checkbox"/>	Secured to wall or stand		
<input type="checkbox"/>	Protected from roof runoff by gutter, rain cap, gable end, or overhang		
<b>Line Set</b>			
<input type="checkbox"/>	Manufacturer specified length (feet)	Minimum:	Maximum with factory charge: Maximum:
<input type="checkbox"/>	Actual line set length:		
<input type="checkbox"/>	Refrigerant added, if required by manufacturer:	Pounds:	Ounces: NA:
<input type="checkbox"/>	Line set prepared per manufacturer guidelines (if available), OR: <ul style="list-style-type: none"> <li>- Confirms line set can hold a pressure above 400 PSIG for 10 minutes, AND</li> <li>- Confirms line set can hold a vacuum level below 500 microns for 10 minutes</li> </ul>		
<input type="checkbox"/>	Flare connections tightened using manufacturer's torque specification		
<input type="checkbox"/>	Visible line sets covered (except for unflashed spaces and space between house and outdoor unit)		
<input type="checkbox"/>	Line set covers connected to transition and/or termination fittings		
<input type="checkbox"/>	Line set: <ul style="list-style-type: none"> <li>- Is either not coated (galvanized), OR</li> <li>- Is coated (epoxy/polyurethane), OR</li> <li>- Meets manufacturer specifications</li> </ul>		
<input type="checkbox"/>	Floor/wall/ceiling penetrations sealed (no visible spray foam)		
<input type="checkbox"/>	Condensate line installed without dips or traps		
<b>Indoor Unit</b>			
<input type="checkbox"/>	Level:		
<input type="checkbox"/>	All ductwork insulated to R8 and sealed		



3. Becoming a RRV or QP - 6

One key document that acts as the foundation for this training -- and that we will refer to throughout -- is the Residential Heat Pump Installation Requirements Checklist.

The checklist must be followed for every residential heat pump rebate.

As we go through this presentation, we've placed a red star next to the mandatory items.

## Residential Quality Inspections

- Inspection of 10-15% of installations to ensure program compliance
- Find/share best practices
- Homeowners can opt in/out
- Based on Installation Requirements Checklist
- Corrective action may be required to remain an active Residential Registered Vendor
- Homeowner decides if inspection report shared with installer



3. Becoming a RRV or QP - 7

Finally, we have a team of field inspectors that visit residential heat pump installations to ensure that installations comply with our program guidelines. Field inspectors also look to find and share best practices with all installers. This helps us improve quality standards in the industry.

This free offering is available to all participating homeowners.

Efficiency Maine inspectors use the Installation Requirements Checklist as the basis of their inspections. An inspection report is always shared with the homeowners and, with the homeowner's permission, those reports may also be shared with the installer.

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This completes the section on becoming a trade ally in Efficiency Maine Programs. Click the “Next lesson” button below to move to the next section on heat pump myths and facts.



## 4. Heat Pump Myths and Facts



One of the things that you know as a heat pump installer is that there are a lot of misconceptions about the technology, even with more and more people installing them in their homes and businesses. Let's go over a few of the more common myths so you have more resources to share with your customers when they come up.

## Myth: “Heat pumps need backup in the cold”

### Facts:

- Units that qualify for Efficiency Maine rebates work well in cold weather.
- Some are rated to work down to -22°F or lower.
- Although their capacities drop at low temperatures, some can produce 100% of rated capacity at -15°F. A properly sized unit will keep occupants warm all winter.



4. Heat Pump Myths and Facts - 1

Myth: Heat pumps need backup in the cold.

Fact: As long as a heat pump system is properly designed, there should be no need for backup. Some heat pumps work at temperatures as low as negative 22 degrees Fahrenheit. It is increasingly common for new houses to be heated and cooled exclusively with heat pumps. Older homes are also converting exclusively to heat pumps.

## Myth: “Heat pumps aren’t efficient in the cold”

### Facts:

- Although they get less efficient at lower temperatures, even at  $-15^{\circ}\text{F}$ , many qualifying heat pumps are far more efficient than any combustion system.
- Even at temperatures near and below  $0^{\circ}\text{F}$ , rebate-eligible heat pumps can be nearly 200% efficient.



4. Heat Pump Myths and Facts – 2

Myth: Heat pumps aren’t efficient in the cold.

Fact: Though they lose efficiency as the outdoor temperature drops, even at temperatures near zero degrees Fahrenheit, rebate-eligible heat pumps can be nearly 200% efficient.

That’s twice as efficient as the most efficient boiler or furnace.

## Myth: “Heat pumps only work in superinsulated homes”

### Fact:

- Properly sized units work well in almost any residential space.



4. Heat Pump Myths and Facts – 3

Myth: Heat pumps only work in superinsulated homes.

Fact: While it is wise to have a well-insulated home, a properly sized heat pump can be used to heat virtually any home.

Tens of thousands of Maine homes successfully heat with heat pumps and most are **not** superinsulated.

## Myth: “Multi-zone systems cost less than multiple single-zone units”

### Facts:

- Multi-zone systems typically cost more to operate.
- After rebates, single-zone systems can cost less to install.



4. Heat Pump Myths and Facts – 4

Myth: Multi-zone systems cost less than multiple single-zone units.

Fact: Multi-zone systems typically cost more to operate, and with rebates, single-zone systems can cost less to install.

## Myth: “Turning down heat pumps at night saves energy.”

### Facts:

- This is not true for heat pumps.
- A DOE study found that leaving the thermostat at a constant temperature uses roughly half the amount of energy as nightly setbacks.



4. Heat Pump Myths and Facts - 5

Myth: Turning down heat pumps at night saves energy.

Facts: While this is true for furnaces and boilers, it is ***not*** true for heat pumps. Heat pumps save the most energy when allowed to maintain a constant temperature. In fact, a Department of Energy study from 2015 found that leaving the thermostat at a constant temperature uses roughly half the amount of energy as nightly setbacks. That’s why we recommend that people, “set it and forget it.”

## Myth: “You should only use your heat pumps in mild weather.”

### Facts:

- Heat pumps are more efficient in mild weather.
- Heat pumps are always more efficient than furnaces and boilers.
- Some heat pumps work as low as negative 31 degrees Fahrenheit.
- Windchill doesn't impact heat pumps (that's why they have fans).
- R410A boils at negative 55 degrees Fahrenheit.



Myth: You should only use your heat pumps in mild weather.

Fact: While there **are** temperatures at which an oil boiler is cheaper to run than a heat pump, there are very few hours per year when this is true. Modeling shows the potential savings of switching to a furnace or boiler during those hours is minimal, and failure to switch back at precisely the right temperature could actually **increase** costs.

## Myth: “When using heat pumps, leave your boiler on to prevent it from leaking.”

### Facts:

- You do not need to leave your boiler on.
- Installing new gaskets or draining the boiler will prevent leaking.



4. Heat Pump Myths and Facts - 7

Myth: When using heat pumps, leave your boiler on to prevent it from leaking.

Fact: There is some truth to the claim that some boilers will leak when turned off, but the solution is not to keep your boiler on. Instead of running the boiler when it's not needed for heating, try turning it off and either replacing the gaskets or draining it.

**Myth: “When using heat pumps, leave your boiler on to prevent pipes from freezing.”**

**Facts:**

- Keeping a boiler running is inefficient and unnecessary.
- Insulate basement walls or add antifreeze to the distribution system to ensure that pipes don't freeze.



4. Heat Pump Myths and Facts – 8

Myth: When using heat pumps, leave your boiler on to prevent pipes from freezing.

Fact: You do not need to keep the boiler running to make sure the pipes don't freeze. If you are worried about frozen pipes, you can minimize this risk with insulation, heat tape on at-risk pipes, or space heaters set to keep the temperature just above freezing.

## Myth: “Insurance isn’t available for homes heated exclusively with heat pumps.”

### Fact:

- While some insurance companies don’t yet offer insurance for homes heated exclusively with heat pumps, we have a list of insurance companies that do offer insurance for heat pump-heated homes on our website.



4. Heat Pump Myths and Facts – 9

Myth: Home insurance isn’t available for homes heated exclusively with heat pumps.

Fact: While some insurance companies don’t **yet** offer insurance for homes heated exclusively with heat pumps, we have a list on our website of insurance companies that **do** offer insurance for heat pump-heated homes.

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That concludes our heat pump myths and facts section. You can find more frequently asked questions about heat pumps on the Efficiency Maine website. As a heat pump installer you can help dispel these myths to ensure customers save the most and get the most out of their systems.

To move to the next section, click the “Next Lesson” button on the lower right hand side of your screen.



In this section, we're going to talk about selecting indoor and outdoor units.

## Indoor Unit Types



WALL UNIT



FLOOR UNIT



CEILING CASSETTE



DUCTED



5. Selection - 1

Let's start with **types** of indoor units, specifically wall units, floor units, ceiling cassettes, and ducted.

On the next slide we're going to talk about some of the advantages and disadvantages of each.

## Indoor Unit Types (continued)



### Wall Units — Most visible

Most popular, most efficient, and condition a large area.



### Floor Units — Less visible

Less efficient, less capacity, subject to airflow obstruction that limits conditioned area.



### Ceiling Cassettes — Nearly invisible

Less efficient, less capacity, limited conditioned area.



### Ducted — Nearly invisible

Well-suited for houses with small rooms, especially if they're ducted within the thermal envelope. On the other hand, ducted units risk significant heat loss if they're improperly sealed and insulated. They also heat all the rooms in the zone regardless of whether or not it's needed.



5. Selection - 2

Wall units are by far the most popular. They're the most efficient, and can condition a large area because they have a high volume of air going through them. Because they're mounted high on the wall, they are rarely obstructed by furniture.

The **drawback** of a wall unit is that because they're up high, they tend to be the most visible.

Floor units are much less obtrusive. **However**, they tend to be less **efficient**, tend to have less **capacity**, and their airflow can be impeded by furniture, which reduces the amount of area that they might condition.

Ceiling cassettes are nearly invisible, which can be an advantage. They tend to be somewhat less efficient and may have less capacity.

Ducted units are also nearly invisible, and they're well-suited for houses with small rooms, especially if they're ducted within the thermal envelope. On the **other** hand, ducted units risk significant heat loss if they're improperly sealed and insulated.

They also heat all the rooms in the zone regardless of whether or not it's needed.

## Several Single-Zones vs. One Multi-Zone

Consideration	Several Single-Zones	One Multi-Zone
Comfort	<b>Only heat/cool rooms that need it</b> and different rooms can be set to <b>different modes</b> (e.g., AC, dehumidify, fan-only).	All indoor units connected to the same outdoor unit must be in the <b>same mode</b> . <b>All indoor units get heat</b> if only one calls for it.
Savings	Tend to have <b>higher efficiencies</b> and can throttle down to lower speeds.	Can't throttle down as low without <b>cycling on and off, which is inefficient</b> .
Backup	If one unit fails, <b>the rest will still operate</b> .	If outdoor unit fails, <b>all connected indoor units are inoperable</b> .
Aesthetics and Cleaning	<b>More outdoor units</b> to install and maintain.	<b>Fewer outdoor units</b> to install and maintain.
Efficiency	<b>Can be sized for each conditioned space</b> and <b>throttle down much lower</b> before cycling on and off.	Often <b>effectively oversized</b> and can <b>short-cycle</b> for significant portions of heating season.



5. Selection - 3

Another point to address is **single-zone** vs. **multi-zone** systems. Comfort, savings, and backup are the three primary advantages of **single-zone** heat pumps. Single-zone heat pumps are comfortable because they only heat and cool rooms that **need** it, and because they allow users to have each room in a different mode: for example, AC, dehumidify, and fan-only.

Single-zone heat pumps generally result in more savings because they tend to have higher **efficiencies** and can throttle down to lower speeds without cycling on and off, which can save **energy**, especially in the shoulder seasons.

Lastly, when there are multiple **single-zones** instead of a single **multi-zone**, you have a backup — if one unit fails, the other zones would still be operable. One **disadvantage** of single-zones is that more outdoor units and wiring are required.

Now let's talk about **multi-zone** systems. Because multi-zone outdoor units connect to more than one indoor unit, they can be less expensive to install, less expensive to clean, and require fewer outdoor units than several **single-zone** heat pumps. One **disadvantage** of a multi-zone system is they deliver heat to **all** the connected indoor units at once as long as **one** of them is calling for heat — even if the others are **not** calling for heat. One tip to minimize this issue is to avoid having one outdoor unit serve more than one floor. Because they tend to have higher

capacities and worse turn-down ratios, multi-zone systems are often effectively oversized, resulting in expensive short-cycling for large portions of the heating season. If you don't run ***all*** of the indoor units simultaneously, the result may be an oversized, inefficient system.

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This concludes the section on “selection.” Next, we’ll talk about sizing. Please click on the “Next Lesson” button to move forward.



Now, let's discuss sizing.

## Oversized Is Not Better

1. Oversized units can cost money to operate because of short cycling
2. Oversized units may “supercool” during AC which can make rooms feel “clammy”
3. Larger units typically have lower rated efficiencies and may have higher operating costs



6. Sizing - 1

The first point is that bigger is not always better.

Oversized units can cost more to buy and, because they're more likely to **short**-cycle, they can cost more to operate.

Oversized units may also “super cool” in air conditioning mode, which can make the room feel clammy. The reason for this is that the unit may lower the temperature without removing all the humidity.

Lastly, larger units tend to have lower-rated efficiencies, which means they may have higher operating costs.

## Sizing Process and Tools

- Determine heating load based on Manual J software, Efficiency Maine's Heat Load Estimator web tool, or square footage method.
- Use the manufacturer-claimed maximum heating capacity at or below design temperature to meet the heat load at design temperature.



6. Sizing - 2

Another general sizing principle is that small units can have **big** capacities at **low** temperatures. Even if they have lower rated capacity, small heat pumps tend to perform well at low temperatures, which is an important feature in our climate.

So, rather than using the **rated** capacity, you'll need to use the manufacturer-claimed **maximum heating** capacity at or below design temperature to meet the heat load at design temperature.

Efficiencymaine.com has links to a list of several commercially available software packages that can estimate the maximum heating load of a home based on the insulating capacity of a home's walls, doors, and windows. They also provide the design temperature for the geographic location of the home. This is the temperature the location will stay above, 99% of the time.

A second way to estimate a home's peak heating load is the Heat Load Estimator tool on Efficiency Maine dot com. It estimates peak heating load of a home based on historic fuel use and it provides the design temperatures of 3 regions: Portland,

Bangor, and Caribou.

To size equipment properly, make sure the manufacturer-claimed maximum heating capacity at or below design temperatures **exceeds** the home's peak heating demand. Note, this is not the same as "**rated capacities**." What is typically referred to as a "9,000 Btu-per-hour heat pump" may not be able to produce 9,000 Btus per hour at low temperatures. This is important.

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That concludes our section on sizing. To move on to the placement section, please click the “Next Lesson” button on the lower right.



We are now going to discuss placement of the indoor unit and outdoor unit, as well as placement of the line set and condensate line. Let's begin with indoor unit placement.

## Indoor Unit Placement



- Indoor units should be located where each can condition as much space as possible.
- Consider locating indoor units where they will be accessible for cleaning
- Consider impact of staircases—heat rises, cool air falls



7. Placement - 1

Here are some of the criteria to consider:

Indoor units should be located where each can condition as much space as possible. They can be located on walls, in ceilings and under floors.

Ideally, indoor units should be located where they'll be accessible for easier cleaning; for instance, not high on a wall in a room with a cathedral ceiling.

Also consider the impact of staircases. It's very difficult for **heat** to go past a staircase that goes **up**. And it's difficult for **air conditioning** to bypass a stairwell that goes **down**.

## Indoor Unit Placement (continued)

- Tough to move air through doorways and down dead-end hallways
- Consider all options
  - Wall units
  - Floor units
  - Ceiling cassettes
  - Ducted units
- Pick spots easy to wire/plumb
  - Backing up to closet, unfinished stairwells, garages, basements, crawlspaces, attics, and outside walls
  - Avoid condensate pumps in bedrooms (noise reasons)



7. Placement - 2

Continuing on indoor unit placement, it's tough to move air through doorways and can be very difficult to move air down a dead-end hallway. Every house is different so these are just general rules of thumb.

One approach to consider when evaluating the location of the indoor unit is to first look for a location where a wall unit could be mounted. If there aren't any good opportunities -- for example a room with many windows -- then you might look for a place where a **floor** unit might be installed. If you can't find a space for either a wall unit or a floor unit, you might then consider a ceiling cassette or a ducted unit.

By going in this order, you will have the advantage of trying to get the most efficient indoor unit first, before exploring other indoor unit options.

Picking spots that are easy to wire and plumb also makes sense. It's easiest to run line set through spaces like a closet, unfinished stairwell, or garage. You may find your customers are happiest if you avoid putting condensate pumps in bedrooms,

because they can make noise during the air conditioning season.

## Line Set Placement



Minimize line set length, while also respecting manufacturer minimum lengths.



7. Placement - 5

Now let's move from siting the indoor unit to line set placement.

First of all, from an aesthetics, heat loss, and installation cost point of view, it makes sense to minimize line set lengths. If the manufacturer has minimum lengths you'll want to honor those.

## Line Set Placement

Minimize visible indoor line set (use drop ceilings, closets, attics, basements, crawlspaces, garages, etc.)



7. Placement - 6

It's ideal to minimize the visible indoor line set as much as possible. You may be able to use drop ceilings or take advantage of closets, attics, basements, stairwells, crawlspaces, or garages. This will make for a less obtrusive and more visually pleasing installation. While this won't impact efficiency, it may help you get more referrals.

## Line Set Placement

Protect from damage (lawn mowers, falling ice, wood piles, etc.)



BAD



GOOD



7. Placement - 7

The picture on the left shows an unprotected line set that could be hit with snow coming off the roof, bumped by a passing lawn mower, or damaged by other hazards. The unit shown on the right has a protected line set -- with a roof and a cover.

There are a couple other unrelated problems in the left picture. ***One*** unit is blowing its exhaust into the ***other's*** intake, which is not ideal. You can also see that they are mounted on the ***ground*** which may work fine for ***air conditioning*** but will not work as well when snow accumulates on the ground.

## Line Set Placement

Keep them vertical or horizontal (not diagonal)



BAD



GOOD



7. Placement - 8

A good practice for line set placement is to keep line sets vertical or horizontal, not diagonal.

## Line Set Placement

Consolidate lines into single line cover if possible



BAD



GOOD



7. Placement - 9

On the left we have three line-set covers next to each other, rather than just one containing all three line-sets.

On the right hand side you can see multiple line sets going through one line set cover, which may be more aesthetically pleasing for the customer.

## Line Set Placement

Stay near gutters, trim, and other wires — avoid cluttering open spaces



BAD



GOOD



7. Placement - 10

Another best practice that we've observed is keeping the line set near gutters, trim or other existing wires, to avoid cluttering up open spaces.

In the left photo, you see two line-sets a few inches apart and a third several feet away; and they're white on red siding. In the right photo, the line-set is right next to a gutter of the same color, blending into the side of the house.

## Line Set Placement

Avoid visible sides of house



BAD



GOOD



7. Placement - 11

Another good practice is to try to avoid outdoor units and line sets on visible sides of the house.

Here on the left you can see a home needing an indoor unit on the end of the house. Instead of putting the outdoor unit there, it was placed on the front of the house. In fact, there are three on the front of the house, which is covered with line sets and outdoor units.

On the right, the outdoor unit is tucked onto a foundation underneath a deck and the result is an unobtrusive installation.

## Outdoor Unit Placement

- ★ Mount at least 18" above any surface where snow will accumulate, unless protected from snow.



BAD



GOOD



★ Efficiency Maine Installation Requirements Checklist

7. Placement - 12

Now we'll discuss outdoor unit placement. The red star on the slide means that this is a requirement on our Installation Requirements checklist.

To be eligible for rebates, units must be mounted at least 18 inches above any surface where snow will accumulate -- whether that's a deck or the ground -- unless they are protected from snow. On the left you can see two problems. The first is that one of the units is blowing into the other. Second, they're on the ground so these units, while they may work in the summer, will need to be shoveled out in the winter.

In the right photo, you can see that the unit is up off the ground clear from snow.

## Outdoor Unit Placement

Unobstructed airflow — avoid shrubs, risk of snow drifts, and structures that may block airflow.



BAD



GOOD



7. Placement - 13

Unobstructed airflow is critical. Outdoor units should be placed in locations that are not obstructed by shrubs, snow drifts or any structures that may block airflow.

Customers may be tempted to hide a unit for aesthetic reasons, but it must have access to unobstructed air flow. On the left is an example of two units obstructing each other.

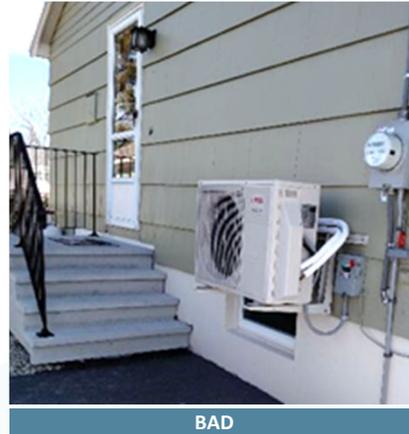
## Outdoor Unit Placement

Should not interfere with walkway, porch, deck, window, or door.

★ Water from defrost will not form ice on walkway.



BAD



BAD



★ Efficiency Maine Installation Requirements Checklist

7. Placement - 14

Another installation suggestion is the outdoor unit should not interfere with a walkway, porch, deck, window, or door. A rebate requirement is that water from defrost will not form ice on a walkway.

These two installations probably could have been done differently. The one on the left creates an ice hazard for the door right next to it. On the right, you can see that the outdoor unit partially blocks the stairs to the house.

## Outdoor Unit Placement

Avoid placing the outdoor units near dryer vents — lint has the potential to clog the coils



7. Placement - 15

Avoid placing outdoor units near dryer vents. Sometimes the lint that comes out of a dryer vent can collect on a heat pump, causing it to clog prematurely and require cleaning.

## Outdoor Unit Placement

Make it serviceable. Make it easy for the service tech — it might be you.



BAD



GOOD



7. Placement - 16

When choosing the outdoor location, consider serviceability. The one on the left, installed between stories, will be difficult to service. The one on the right is at a convenient, serviceable height.

## Outdoor Unit Placement

Mounting at the base of a wall or corner, rather than the middle, will minimize noise



BAD



GOOD



7. Placement - 17

Lastly, consider the noise impact of the outdoor unit when choosing a location.

The quietest mounting options are on a stand or foundation bracket. If an outdoor unit has to be mounted on a framed wall, installing it at the base of the wall or at the corner of the house rather than the middle of the wall may help.

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That concludes the placement section. Please click the “Next Lesson” button on the lower right hand side of the screen to move on to the installation section.



## 8. Installation

Now, let's talk about installation.

## Indoor Unit Installation

- ★ Ensure level (to drain condensate)



★ Efficiency Maine Installation Requirements Checklist

8. Installation - 1

The first step in indoor unit installation is to make sure the unit is level so the condensate drains properly. This is a requirement for rebates.

## Indoor Unit Installation

Observe service clearances



8. Installation - 2

The next step is to make sure to observe all service clearances.

# Outdoor Unit Installation

Unit should be level and plumb



BAD



GOOD



On the exterior, we recommend that the outdoor unit is level and plumb.

## Outdoor Unit Installation

- ★ Outdoor unit and line set protected from roof runoff by gutter, rain cap, gable end, or overhang.



BAD



GOOD



GOOD — If Under a Metal Roof



★ Efficiency Maine Installation Requirements Checklist

8. Installation - 4

by a gutter, rain cap, gable end, or overhang.

On the left you can see the outdoor unit is installed beneath a roof valley of a house where a significant amount of ice and snow have come down on both the outdoor unit and line set. Snow and ice can damage the line set between the outdoor unit and the house.

The middle photograph shows a better installation. You see a rain cap is protecting the outdoor unit from rain and it's close to the house to protect the unit from falling ice.

In the right-hand photo, the installer has put a custom **roof** over the outdoor unit. This is critical under a metal roof where a lot of snow and ice can fall at once. Proper protection is a requirement on our Checklist.

## Outdoor Unit Installation

★ Outdoor unit secured to wall bracket or stand.  
If ground mounted, there must be a stable base.



BAD



GOOD



★ Efficiency Maine Installation Requirements Checklist

8. Installation - 5

Outdoor units must be secured to a wall bracket or stand. If the unit is ground mounted, it needs to be on a stable base. As seen here, a pad is a better option than a stand directly on the ground.

## Outdoor Unit Mounting Options

- **Wall mounts** keep units away from snow, rakes, and mowers, but can transmit noise inside.
- **Ground stands** minimize noise, but can be susceptible to frost heaves if installed with inadequate drainage. Consider adjustable legs.
- **Foundation brackets** minimize noise and stay out of the way of rakes and lawn mowers.



5. Selection - 6

Now, let's talk about all outdoor unit mounting options.

There are three general approaches: wall mounts, ground stands, and foundation brackets.

Wall mounts are effective because they keep the units off the ground, away from snow, rakes, and lawn mowers. However, as we discussed before, if the wall mount is attached to the wooden framing of the house, it can transmit noise inside.

A ground stand can minimize noise transmission but may be susceptible to frost heaves.

If you've decided on a ground stand, one thing to consider is adjustable legs. In the spring, if you see that the unit has shifted due to frost heaves, you can adjust the stand and make the unit level again.

A foundation bracket, which bolts onto the foundation of the house, gets the unit off the ground and reduces noise transmission.

## Outdoor Unit Mounting

To reduce noise risk, consider rubber isolation gaskets between the outdoor unit and the brackets, and between the brackets and the house.



GOOD



GOOD



8. Installation - 7

Another way to reduce the risk of noise is to use rubber isolation gaskets between the outdoor units and the brackets, and between the brackets and the house, as seen here.

## Line Set Installation Requirements

### ★ Requirements

- Length and refrigerant amount per manufacturer's guidelines
- Purged with nitrogen, pressure tested and evacuated per manufacturer's instructions. If the manufacturer does not offer instructions, the Efficiency Maine procedure should be followed. (See next slide.)
- Flare connections tightened using manufacturer's torque specification

### ★ Efficiency Maine Installation Requirements Checklist

### Recommendations

- Use bending tool if necessary to avoid kinks when bending.
- Crimp, tape, or cap loose ends of line set to keep clean until final connection.



8. Installation - 8

Moving on to line set installation -- line set installation requirements vary depending on manufacturer.

In order to be eligible for a rebate, line sets must be purged with nitrogen, pressure tested, and evacuated according to the manufacturer's instructions.

## Efficiency Maine Line Set Preparation Procedure

### ★ Requirement

- Line set prepared per manufacturer guidelines (if available), or:
  1. Confirm line set can hold a pressure above 600 PSIG for 10 minutes, and
  2. Confirm line set can hold a vacuum level below 500 microns for 10 minutes

★ [Efficiency Maine Installation Requirements Checklist](#)



8. Installation - 9

If the manufacturer does not offer instructions, the Efficiency Maine procedure should be followed. This procedure was based on conversations with manufacturers, distributors, and installers.

## Torque Chart

★ Flare connections tightened using manufacturer's torque specification

Mitsubishi		
Pipe Diameter	Tightening Torque	
	Ft-lb	N-m
1/4 "	10 to 13	13.7 to 17.7
3/8 "	25 to 30	34.3 to 41.2

Daikin		
Pipe Diameter	Tightening Torque	
	Ft-lb	N-m
1/4 "	10.4 to 12.7	14.2 to 17.2
3/8 "	24.1 to 29.4	32.7 to 39.9

Fujitsu		
Pipe Diameter	Tightening Torque	
	Ft-lb	N-m
1/4	11.8 to 13.28	16 to 18
3/8	23.6 to 30.9	32 to 42



★ Efficiency Maine Installation Requirements Checklist

8. Installation – 10

Follow manufacturer guidelines regarding the tightening of flare connections. **Over-**tightening can cause leaks. Here are some sample torque specifications from some manufacturers.

## Line Set Installation

- ★ 1. Visible line sets covered (exception: unfinished spaces and space between house and outdoor unit)
- ★ 2. Line set covers secured by transition and/or termination fittings.



BAD



GOOD



★ Efficiency Maine Installation Requirements Checklist

8. Installation - 11

Another Efficiency Maine requirement is that visible line sets must be covered by line set covers with **transition** and **termination** fittings. There are only two exceptions to this requirement. One is where the line set runs through unfinished spaces and the other is the span between the house and the outdoor unit.

On the left, you can see that there are **no** termination fittings. On the right, the termination fittings secure the cover to the house. These fittings protect the line set and provide structural support to the cover. Line set covers themselves are **not** structurally strong.

## Line Set Installation

Insulation covers full length of line sets (no exposed copper)



BAD



GOOD



8. Installation - 12

We recommend that insulation covers the full length of the line sets leaving **no** exposed copper. In the left photo you can see the installer cut the insulation back to make it easier to install the line set. This created a point of **heat** loss. In the right-hand photo you can see the installer did an **excellent** job of covering **all** the copper.

## Line Set Installation

- ★ Floor/wall/ceiling penetrations sealed (no visible spray foam)



BAD



GOOD



★ Efficiency Maine Installation Requirements Checklist

8. Installation - 13

Another rebate requirement is to seal all floor, wall, and ceiling penetrations. You can see in the left photo there is an opportunity for water, snow, and pests to come in next to that line set.

In the right-hand photo, the penetration is well sealed.

## Line Set Installation

- ★ Line set:
  - is either not coiled (preferred), OR
  - is coiled horizontally, OR
  - meets manufacturer specifications



BAD



GOOD



★ Efficiency Maine Installation Requirements Checklist

8. Installation - 14

Installers should be certain that the line set is **always** supported. The right-hand picture shows a line set cover that's properly fastened to the house. In the left-hand photo, it's draped and only supported by **zip ties**. You'll also notice that the line set in the picture on the **left** is coiled **vertically**. In absence of alternative manufacturer allowances, if a line set **has** to be coiled, it should be coiled **horizontally**. This is a requirement of our Checklist.

## Line Set Placement

Match color of house



BAD



GOOD



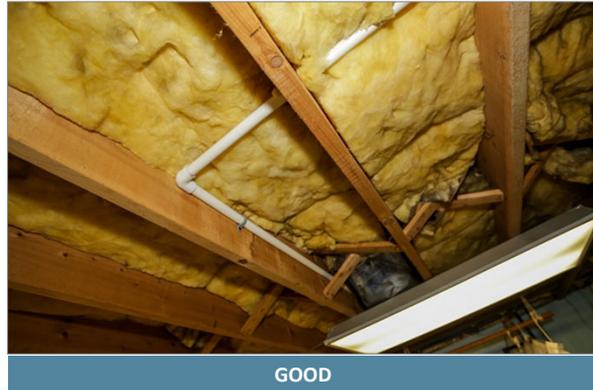
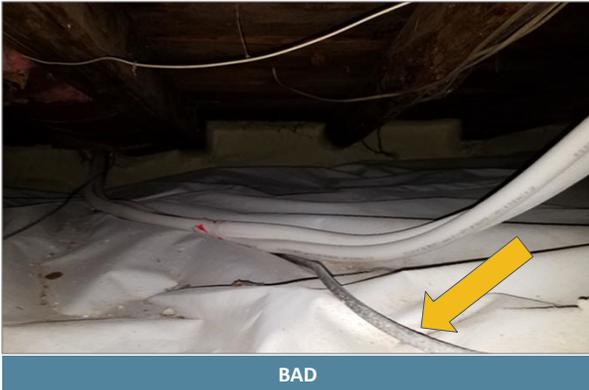
7. Placement - 15

Matching the color of the line-set cover to the house can increase customer satisfaction. In the picture on the right, the line set-cover blends better than the picture on the left.

## Condensate Line Installation

Use rigid pipe (not flexible tubing) for long, low-slope runs.

★ Condensate line installed without dips or traps.



★ Efficiency Maine Installation Requirements Checklist



8. Installation - 16

Condensate lines must be installed without dips or traps. This prevents condensate from backing up into the indoor unit. Even a small dip can back up water multiple feet in the line. This is a requirement of our Checklist.

When possible, use rigid pipe, especially for long, low-slope runs.

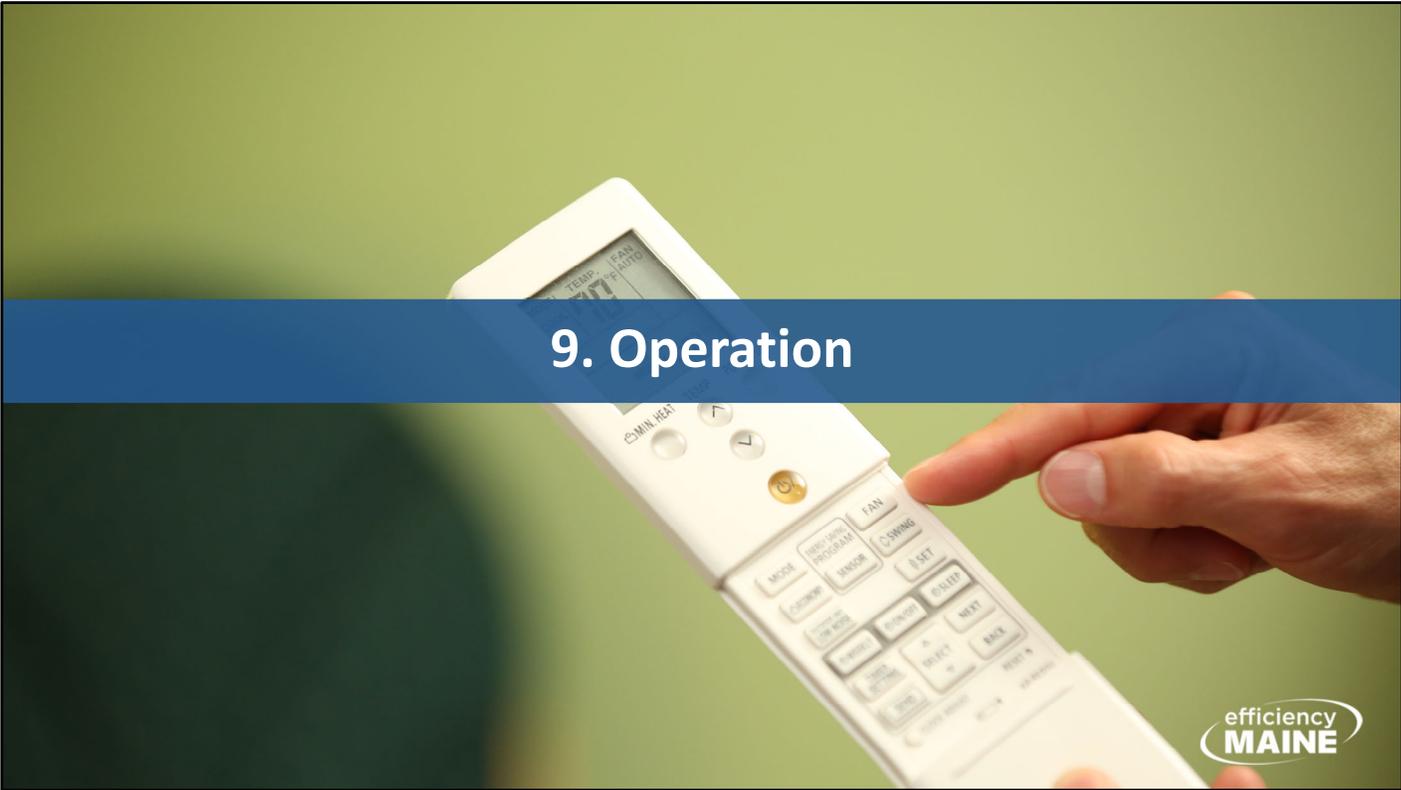
In the photo on the left, you see a dip. In the photo on the right, you see a rigid pipe.

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This concludes the section on Installation. Click the “Next Lesson” button to move on to heat pump operation.

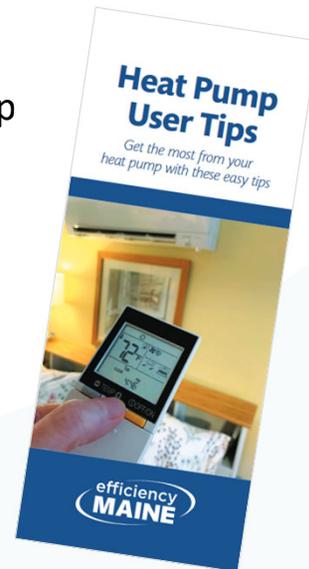


# 9. Operation

Let's review heat pump operation.

## Customer Training

- Give owner's manual to customer.
- ★ Provide customer with Efficiency Maine Heat Pump User Tips.
- ★ Ensure customer understands electric bill may increase, but overall energy use in the winter may decrease if heat pump used optimally.



★ Efficiency Maine Installation Requirements Checklist

9. Operation - 1

Next, we're going to talk about heat pump **operation**.

While **you** know how to operate a heat pump, your customers may **not**. We see that some customers don't get the most out of their heat pump because they don't know how to use it as well as they could. We send customers tips electronically and in the mail to help them, but we also require that installers go through heat pump user tips as part of our Checklist. After reviewing the tips with customers, you can also direct them to the Efficiency Maine website for additional educational resources.

We'll review some of those user tips now and why we include them. Reviewing these best practices can reduce call backs and increase customer satisfaction. And as we discussed earlier, using the heat pump correctly can help customers save energy and increase savings.

## Customer Training (continued)

Installers teach customers to:

- ★ Power unit on and off
- ★ Clean filter
- ★ Switch between heating and cooling modes
- ★ Change the temperature set point
- ★ Adjust airflow direction
- ★ Call for service



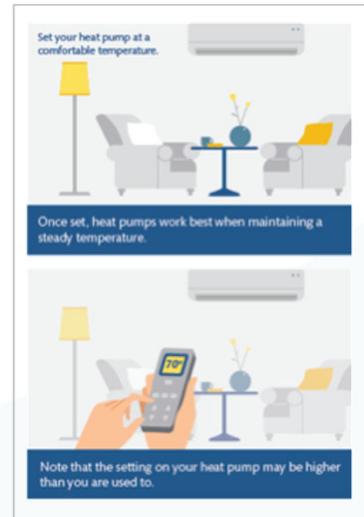
★ Efficiency Maine Installation Requirements Checklist

9. Operation - 2

Some of the basics that we ask you to cover as part of the installation are how to power on and off the unit, how to rinse the filter, how to switch between heating and cooling modes, how to change the temperature set point, how to adjust the airflow direction, and how to call for service. These tips are intended to help customers get the most from their heat pumps.

## User Tip: "Set it and forget it"

- Heat pumps work best when maintaining a steady temperature
- "Set it and forget it"



9. Operation - 3

You'll remember from earlier in the presentation that turning down the heat pump at night to save energy was one of the common myths we hear. Encouraging homeowners to set it and forget it will help them get the most from their system and ensure that the system operates most efficiently.

## Outdoor Unit Maintenance



BAD

- Keep clear of obstructions, like shrubs, leaves, or snow
- Professionally inspected annually, clean as necessary (especially at beginning of heating season)
- Don't worry about frost, they self-defrost



9. Operation - 4

Another important tip to share with customers is the need to keep the outdoor unit clear from obstructions. In general, we recommend that outdoor units be professionally inspected every year and cleaned as necessary.

We've heard from installers that the best time to clean a unit would be at the end of the air conditioning season when the unit has been blowing more dust than you would typically see in the snowy winter.

In addition, you may want to let your customers know that, besides keeping the outdoor unit unobstructed and protected from falling ice and snow from the roof, heat pumps can take care of themselves in the winter. It can be a bit alarming to see an outdoor unit frost up, so you may want to share with your customers that they **don't** need to worry about it.

## Use Your Heat Pump Year-Round



- Heat pumps are the most efficient heating system.
- If you have both a heat pump and a furnace/boiler, a heat pump is the more energy-efficient choice.
- Rebated heat pump(s) must be used to heat the home throughout the heating season.



9. Operation - 5

As we discussed above in the myths and facts section, it's important to reiterate that heat pumps work year-round.

Heat pumps are the most efficient heating system, even on the coldest winter day. If you have both a heat pump and a furnace or boiler, your heat pump is the more energy-efficient choice.

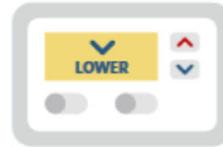
## User Tips: Temperature and Thermostat

- **Choose the Temperature Setting That Makes the House Feel Comfortable**

- This may be higher than the customer is used to

- **Prioritize Your Heat Pumps**

- Use the heat pumps first and use a furnace or boiler only as emergency backup.



BOILER  
THERMOSTAT



HEAT PUMP  
CONTROL



The next user tip is about temperature and thermostat use.

We recommend that customers set their heat pump control for comfort, even if the setting is higher than what they are used to with their boiler or furnace. For instance, someone who may set their *furnace* to **68** degrees may find that this is similar to setting their *heat pump* to **70** degrees.

To maximize savings, customers should be encouraged to use their heat pumps **throughout** the heating season and **only** use a boiler or furnace in an **emergency**, such as a broken heat pump.

## User Tip: Avoid “Auto” Operation Mode

- “Auto” operation mode automatically switches between heating and cooling.
- System could start heating on a cool summer night or cooling on a sunny winter afternoon.
- Set heat pump **Heat** in the winter and **Cool, Dry, or Fan** in the summer.

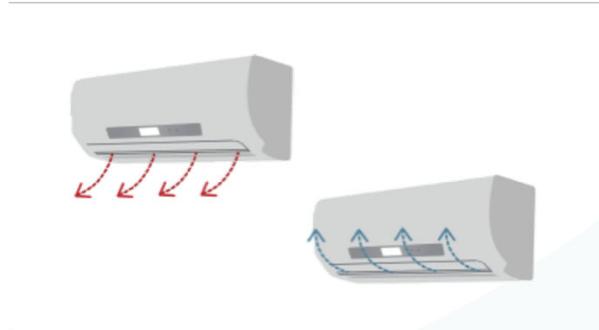


9. Operation - 7

Use heat, cool, dry, or fan, but **not** “**auto**” operation mode because **auto** mode can cause a heat pump to switch to **heat** mode in the middle of a cool summer night, or to **AC** mode on a sunny winter afternoon.

## User Tip: Optimize the Fan Setting and Air Flow Direction

- Fan setting
  - Start with “Auto Fan”
  - If uncomfortable, set a custom speed
- Air Flow Direction
  - Direct warm air towards the floor and away from room occupants
  - Direct cool air up or directly at occupants



9. Operation - 8

While we recommend customers avoid “Auto” **operation** mode, we **DO** recommend starting with “Auto **Fan**” mode to see if that works for their space. If that **doesn't** work, they can adjust the fan’s speed up or down.

We have also found that showing customers how to adjust air-flow direction can help. Aiming warm air directly at an occupant can **actually** make them feel **cold** in the heating season, so generally we recommend directing **warm** air **away** from occupants. On the **other** hand, we recommend aiming **cool** air directly **at** occupants during the cooling season.

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Reviewing these tips and other aspects of operation can help ensure customer satisfaction and savings.

Now that we have gone over operation tips, we can finish up with a few other considerations. Please click the “Next Lesson” button to move to the final section.



In this final section, we'll briefly address some other considerations.

## Minimizing Issues with Abandoned Boilers/Zones

- Boilers that leak when turned off
  - Consider gaskets
  - Consider draining
- Frozen pipes
  - Insulate between pipes and outdoors (don't leave pipes outside the insulation)
  - Consider antifreeze in distribution system



10. Other Considerations - 1

If your customer is switching entirely away from a boiler, they may find the boiler starts to leak once it's turned off.

There are two ways you can avoid this problem. **First**, consider installing rubber gaskets on the boiler. **Another** option is to drain the boiler and distribution system if they are not going to be used.

Turning off a boiler or furnace in an insufficiently insulated basement can increase the risk of pipes freezing. This risk can be minimized with insulation, heat tape on at-risk pipes, or space heaters set to keep the temperature just above freezing.

Another option is to add **antifreeze** to the boiler **distribution** system.

## Insulating Ductwork and Sealing

- ★ All ductwork must be insulated to R8 and sealed.



★ Efficiency Maine Installation Requirements Checklist

10. Other Considerations - 2

In order for **ducted** heat pumps to qualify for rebates, the ductwork needs to be sealed using **duct mastic** or UL-181-rated **tape** to avoid air leakage and **insulated** to at least R8 to minimize heat loss.



This completes our Heat Pump Basics Training. We hope you found it helpful.