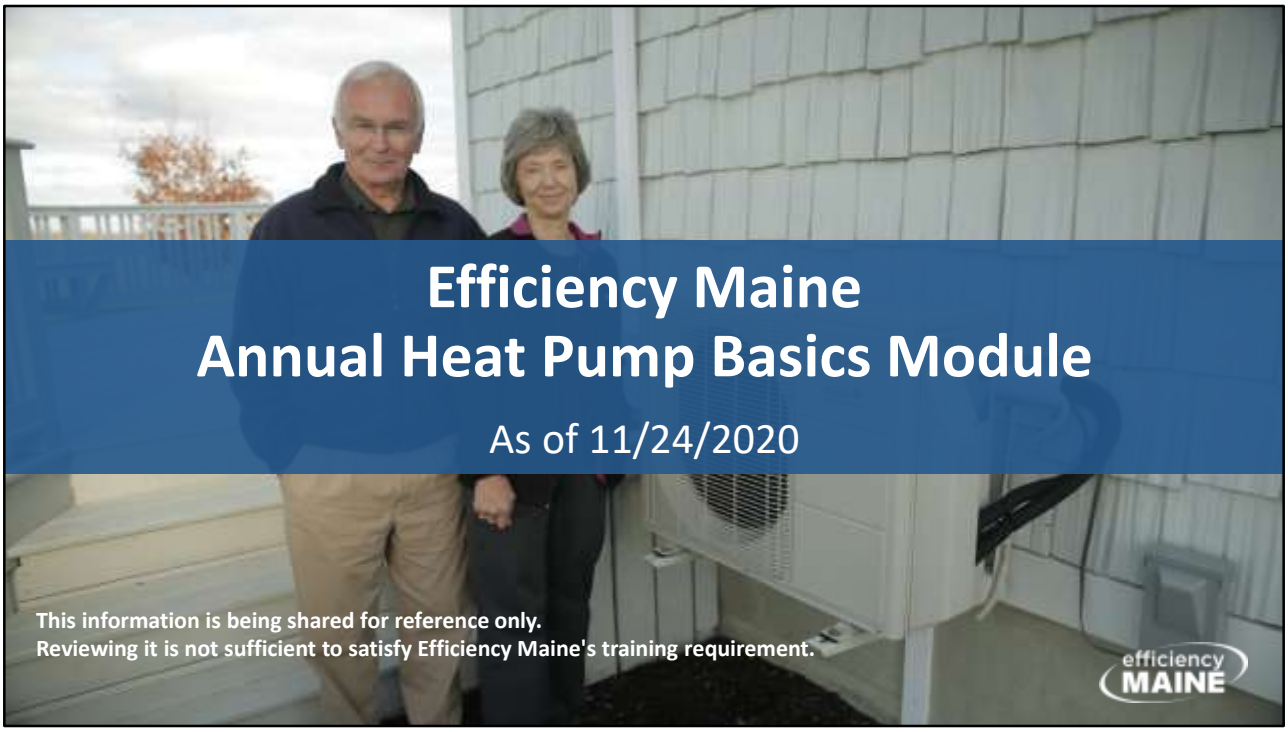

Welcome to the Efficiency Maine Annual Heat Pump Basics Module.

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 ten 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, insulation, operation, and some other heat pump considerations.

The first section is an introduction to Efficiency Maine.

About Efficiency Maine

- Efficiency Maine offers rebates, loans, sales tools, and technical information to help residential and commercial trade allies sell and install energy-efficient products.
- Efficiency Maine funding requires that rebated installations be cost-effective.
- Cost-effectiveness of heat pumps depends on proper placement, sizing, selection, installation, and user training.

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1. Introduction - 1

Efficiency Maine offers rebates, loans, sales brochures, and technical information to help residential and commercial trade allies sell and install energy efficiency products.

Restrictions on our funding requires all rebated installations be 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.

100,000 Heat Pump Initiative

- State Goal: Install 100,000 *high performance* heat pumps over the next 5 years
- Represents more than 2 times current rate of installations receiving rebates
- Goals:
  - 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.

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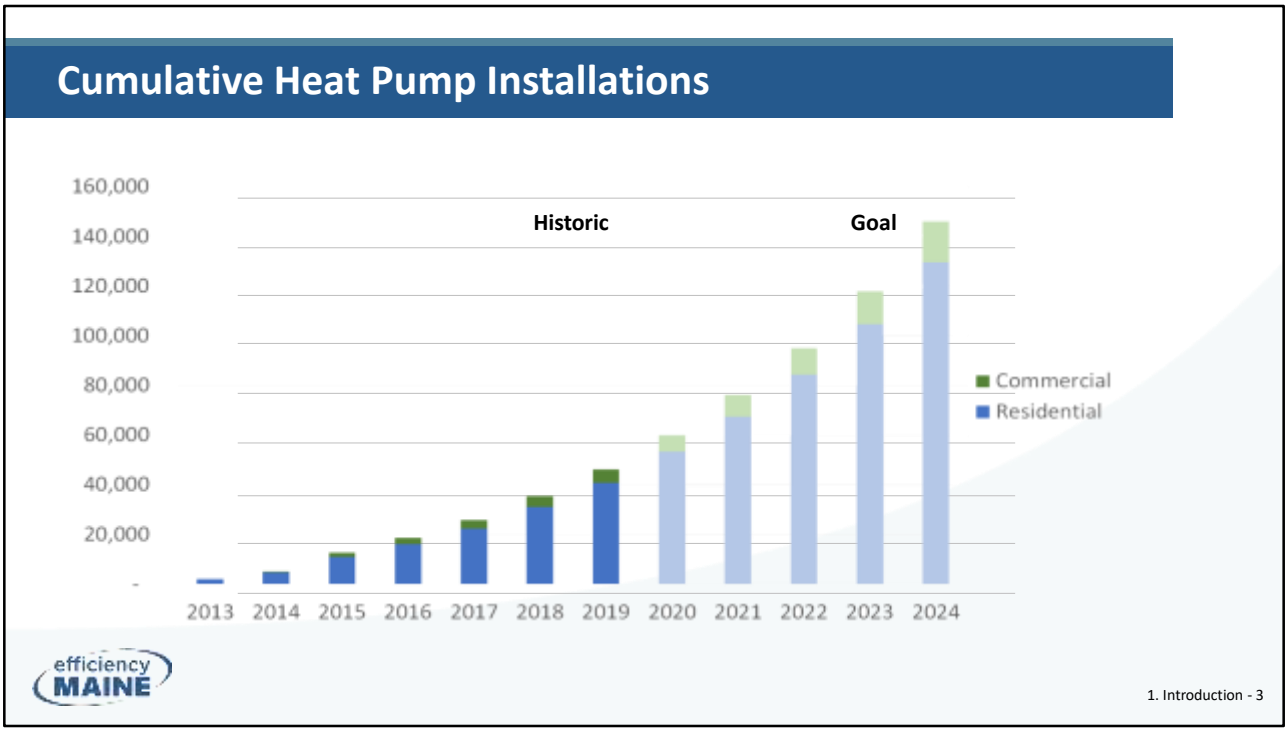
1. Introduction - 2

In 2019, the Maine State Legislature passed a law creating a goal for the state to encourage the installation of 100,000 high-performance heat pumps over the next five years. That represents a doubling of the current rate of installations that receive our rebates.

The goal of the new law is to lower heating bills, achieve carbon reductions, displace heating oil, and grow our economy in a way that benefits all sectors, all income levels, and all geographic regions of the state.



This graph gives you an idea of the opportunity before us. As of 2019, Efficiency Maine had rebated about 45,000 ductless heat pumps.

As you can see, we're going to need to grow that number threefold over the next five years.

About This Video

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

1. Introduction - 4

That's where you come in and why we've asked you to view this video every year so you can continue to meet our rebate program eligibility requirements.

As you know, 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

	Market	Minimum HSPF	1st Indoor Unit	Additional Indoor Units	Max Rebate
1	Residential Tier 1	10.0 for multi-zone 12.0 for single-zone	$500	$250	$750
2	Residential Tier 2	12.5 single-zone, wall unit only	$1,000	$500	$1,500
3	Low-income LIHEAP and Assessed Value	13.0 single-zone, wall unit only	$2,000	$500	$2,500
4	Commercial & Industrial	10.0 for multi-zone 12.0 for single-zone	$500	$250	$1,250

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Max two rebates per home.
Commercial maximum is per heat pump. No limit on number of heat pumps per building.

2. Rebates and Loans - 1

We offer rebates up to $2,500 per home and up to $1,250 per heat pump in commercial buildings. There's no cap on the number of heat pumps that can be installed in a commercial building. Rebates are only available for heat pumps that are installed by Residential Registered Vendors or commercial Qualified Partners.

For more details on rebates and eligibility criteria please visit efficiencymaine.com.

Residential Heat Pump Loans

- Up to $15,000
- 4.99% to 5.99% APR
- 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

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2. Rebates and Loans - 2

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

Customers can borrow up to $15,000 at a 4.99 to 5.99 percent Annual Percentage Rate with up to 10-year 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.”

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

Residential Registered Vendor

Benefits

- Loans
- Leads from Efficiency Maine's Vendor Locator
  (40,000 visits/year)
- Free brochures
- Monthly program updates newsletter

Requirements

- Participation Agreement
- General Liability Insurance
- Workers' Compensation Insurance
- Code of Conduct
- Installation Training
- Per Crew
  - EPA Section 608 Certificate
  - This video

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3. Becoming a RRV or QP - 1

Some of the benefits of being a Residential Registered Vendor -- which is also referred to as an RRV -- are access to the rebates and loans we just reviewed, as well as receiving leads from our website's Vendor Locator, free brochures, and a monthly program update e-newsletter.

Efficiency Maine requires RRVs to sign a participation agreement, have general liability and workers' compensation insurance, and sign the Efficiency Maine code of conduct.

In addition, there are three heat-pump specific requirements. The first is that each RRV must have either manufacturer-approved or other approved heat pump installation training. There are two other crew requirements: at least one person on each crew must have an EPA section 608 (6-oh-8) certificate. And one member of each crew must complete this Annual Heat Pump Basics Training.

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

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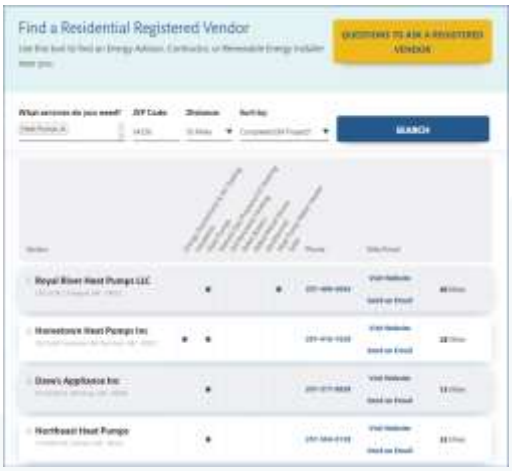
3. Becoming a RRV or QP - 2

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



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3. Becoming a RRV or QP - 3

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 $750 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
- List of Most Commonly Rebated Residential Heat Pumps

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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 can also provide 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, call our Call Center at 866-376-2463.

Residential Installation Requirements Checklist

- Must be submitted as part of the rebate claim process
- Some of the things later in this presentation show up on the checklist as requirements in order for heat pumps to be eligible for rebates. They are indicated as follows:

★ Efficiency Maine Installation Requirements Checklist


RESIDENTIAL HEAT PUMP
Installation Requirements Checklist

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3. Becoming a RRV or QP - 5

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 completed 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

- On-site 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

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3. Becoming a RRV or QP - 6

Finally, we have a team of field inspectors that visit 10 to 15% of 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.

Finally, we have a team of field inspectors that visit 10 to 15% of 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.

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 Don’t Work in the Cold”

Facts:

- High performance units that qualify for Efficiency Maine rebates work well in cold weather.
- Some are rated to work down to -15°F or lower.
- Although they get less efficient at lower temperatures, even at -15°F, qualifying heat pumps are far more efficient than any combustion system.
- Although their capacities drop at low temperatures, some can produce over 100% of rated capacity at -15°F. A properly sized unit will keep occupants warm all winter.

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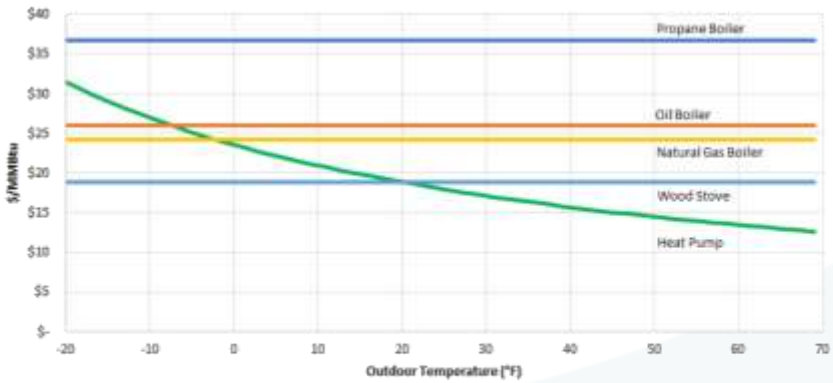
4. Heat Pump Myths and Facts - 1

Myth: Heat pumps don’t work in the cold.

The fact is high-performance units that qualify for Efficiency Maine rebates work **well** in the cold -- really well. Some are even rated to work down to negative 15 degrees Fahrenheit or lower.

And while they do get less efficient at lower temperatures, even at temperatures as low as negative 15, the qualifying heat pumps are going to be far more efficient than any combustion system. Although their capacities also drop at low temperatures, some units can produce more than 100% of their rated capacity at negative 15. This means that a properly sized unit will keep occupants warm all winter.

Myth: "You Should Switch to Oil When It's Below 30°F"



Note: Graph assumes the following: oil boiler Annual Fuel Utilization Efficiency (AFUE) of 83% and cost of $2.97 per gallon; propane boiler AFUE of 86% and cost of $2.87 per gallon; natural gas boiler AFUE of 83% and cost of $2.05 per ccf; wood stove efficiency of 74% and cost of $250 per cord; heat pump seasonal coefficient of performance (COP) of 2.7, manufacturer performance specifications, and cost of $0.16 per kWh. Oil and propane prices are an average of prices from 10/1/2018 to 1/7/2019 from the Governor's Energy Office "Current Heating Fuel Prices" report.

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4. Heat Pump Myths and Facts - 2

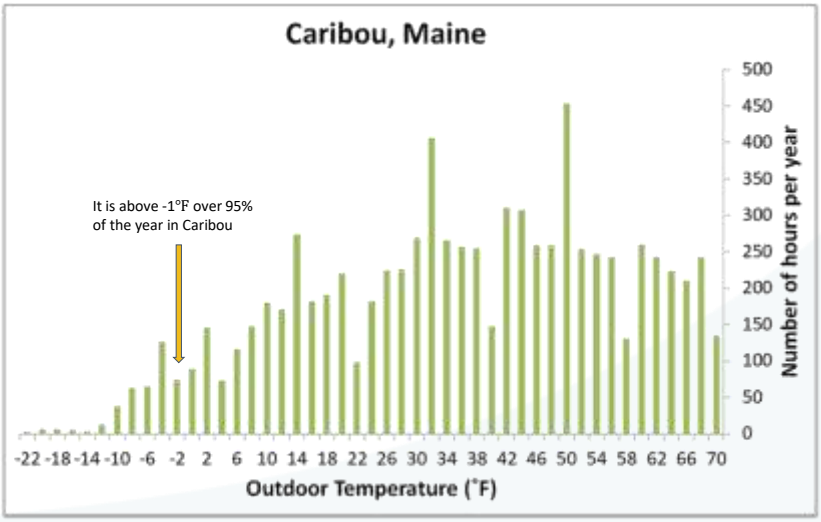
The next myth is that you should switch to oil when it's below 30 degrees Fahrenheit.

The fact is, while this may be true for traditional heat pumps in parts of the country heated with cheap natural gas, heat pumps that qualify for Efficiency Maine rebates can be cheaper to run than oil or propane systems at any temperature above 0 degrees Fahrenheit. The balance point depends on energy prices and system efficiencies.

Question:
How much money would you save switching between your heat pump and oil boiler at -1°F in Caribou?

Answer:
$4 per year*

**Assumes $2.75/gallon oil, AFUE 80.5%, HSPF 12, and $0.16/kWh*



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4. Heat Pump Myths and Facts - 3

As shown in this graph, 95% of the time in Caribou the temperatures are above negative 1 degree Fahrenheit.

In Caribou if you were to switch from your heat pump to oil <u>every</u> time it got below negative 1, you would save about $4 per year at these assumed prices. And that savings assumes that you switch back to the lower-cost heat pump whenever temperatures were above negative 1.

This is just one example. You can compare operating costs of different heating systems using the Cost of Heating calculator on our website.The tool can be adjusted to reflect different system efficiencies and fuel prices.

In Caribou if you were to switch from your heat pump to oil <u>every</u> time it got below negative 1, you would save about $4 per year at these assumed prices. And that savings assumes that you switch back to the lower-cost heat pump whenever temperatures were above negative 1.

This is just one example. You can compare operating costs of different heating systems using the Cost of Heating calculator on our website.The tool can be adjusted to reflect different system efficiencies and fuel prices.

Myth: “Turn your heat pump down at night and when you aren’t home”

Once you have set your heat pump to a comfortable temperature, we recommend you leave the temperature setting alone.

Heat pumps are designed to maintain a steady temperature, and turning them down at night or when you’re away for the day may actually cost you more.

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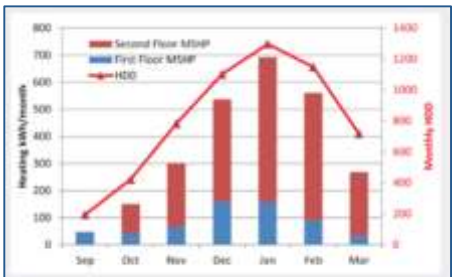
The next myth says you should turn your heat pump down at night and when you aren’t at home.

While this is true for combustion systems, it's **not** true for heat pumps. Let’s look at an example.

Constant Temperature Is More Efficient

Constant set point house



On-off operation house

The Department of Energy monitored homes with two mini-split heat pumps (MSHP) with either constant operation or setbacks. They concluded, "The on-off operation clearly results in greater energy use. The constant set point house showed roughly half the consumption (54%) of the on-off house."

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4. Heat Pump Myths and Facts - 5

These graphs show a comparison between two identical homes using different methods of heat pump operation. The house on the left is a constant set point house. That means the temperature on the thermostat is not touched all day and night. The house on the right, an otherwise identical house, is a house that turns down the thermostat on the heat pump every night.

That red line shows heating degree days -- it's the same on both graphs -- and you can see that the most heat was needed in the middle of January.

The bars represent how much electricity was used by the heat pumps during the heating season. In the example on the left -- the constant set point house -- the amount of electricity used is about half of the electricity used in the house that used nightly setbacks. In this example, using nightly setbacks does not save energy, it actually **doubles** the use of electricity.

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That concludes our heat pump myths and facts section. You can find more heat pump frequently asked questions 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 heat pump selection for indoor and outdoor unit types.

Indoor Unit Types

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5. Selection - 1

Let's start with indoor unit types, namely 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 the largest 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
Good for small rooms and super insulated homes if within thermal envelope.
Risk of significant heat loss with improper installation, sensitive to open/closed doors unless supply & return in each room, heat all rooms in zone regardless of demand.

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5. Selection - 2

Wall units are by far the most popular. They're the most efficient, and can condition the largest 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 is often impeded by furniture, which reduces the amount of area that they might condition.

Ceiling cassettes are nearly invisible, which is considered a big advantage. They tend to be somewhat less efficient, they may have less capacity, and because their supply and return is right next to each other they might condition a more limited area.

Ducted units are also nearly invisible, and they're really good for small rooms and well-insulated homes if they're ducted within the thermal envelope. On the other hand, ducted units risk significant heat loss if they're improperly insulated. They can be sensitive to open and closed doors, unless the supply and return is in the same room. And they tend to heat all the rooms in the zone regardless of whether there's a need to do so.

Single-Zone vs. Multi-Zone

Single-Zone

- **Advantages:** More efficient, can throttle down to lower speeds without cycling on/off which saves energy, reduces temperature cycling, and can more effectively dehumidify. Having multiple single-zone units provides backup and allows users to have each room in a different mode: for example, AC, dehumidify and fan. May be eligible for a larger rebate.
- **Disadvantages:** Higher installation and cleaning cost and more clutter if multiple outdoor units.

Multi-Zone

- **Advantages:** Reduced installation cost, cleaning cost, and clutter compared to multiple single-zones.
- **Disadvantages:** Heat delivered to all the connected indoor units, even if they don't need heat. In a well insulated house, this can overheat some rooms. Generally less efficient than single-zone units.

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5. Selection - 3

Another point to address is single-zone vs. multi-zone.
Single-zone heat pumps, which are by far the most popular, tend to be more efficient. They can throttle down to lower speeds without cycling on and off, which can save a lot of energy in the shoulder seasons. Because they can throttle down, they also reduce the temperature cycling that customers may experience, and they can more effectively dehumidify.
Single-zone units also allow users to have each room in a different mode: for example, AC, dehumidify and fan. Another advantage of single zones is that by having multiple single zones instead of a single multizone, you have a backup -- if one were to break, the other zones would still be operable.
And depending on the efficiency of the unit, single zones may be eligible for a larger rebate from Efficiency Maine.
The disadvantage of a single zone is that they may cost more. Buying multiple single zone units may be more expensive than buying one multizone and would require more outdoor units. The result could be visual clutter on the outside of the home.
Conversely, multi-zones heat several rooms or the whole house and require fewer outdoor units.
The disadvantage of a multi-zone system is they tend to 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 <u>not</u> calling for heat.
In a well insulated house, this can overheat some rooms. Generally, they also tend to be less efficient than single-zones.

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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.

Let’s discuss sizing.

Oversized Is Not Better

1. Oversized units can cost more money to operate because of additional 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

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6. Sizing - 1

The first point is that bigger is not always better.

Oversized units can cost more to buy and, because they’re likely to cycle more, they can cost more to operate. As we saw in the earlier graphs, cycling can waste a lot of energy.

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 adjust the temperature without removing all the humidity.

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

Small Units Can Have Big Capacities

- Match max capacity (not rated capacity) at design temp to heating load at design temp
- Use heating load of zone, not entire house (Design load for a typical home is ~40,000 btu/h at 0°F)

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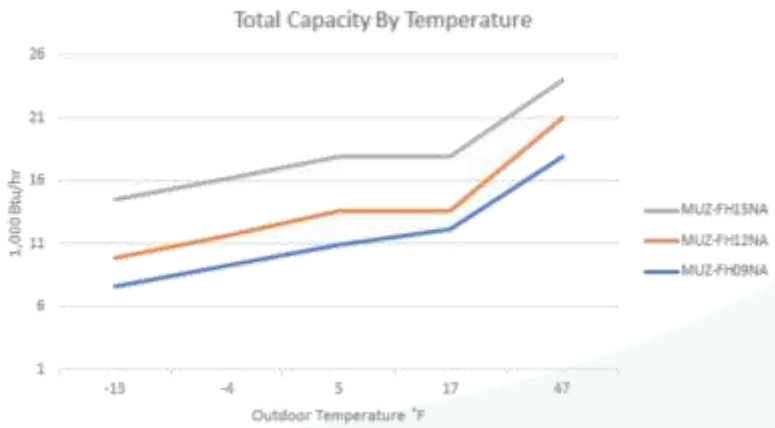
6. Sizing - 2

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

So, we recommend matching the maximum capacity at design temperature to the heating load at design temperature, rather than the rated capacity.

And you'll want to use the heating load of the zone that the heat pump is heating, not necessarily the entire house.

Total Capacity of Most Commonly Rebated Mitsubishi Units



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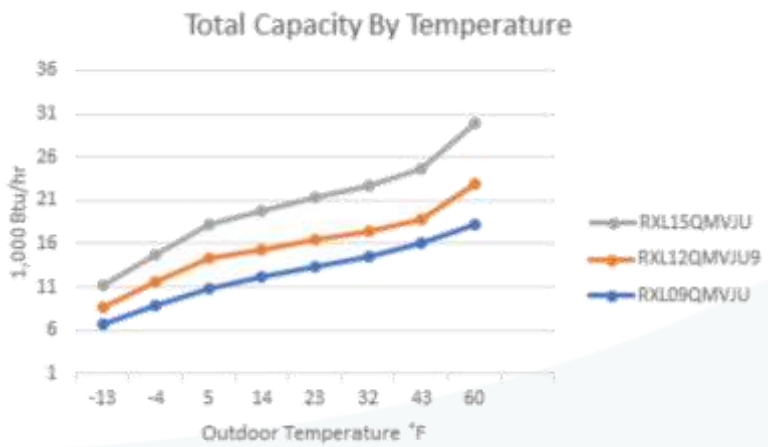
6. Sizing - 3

Let's take a look at the total capacity of one of the most frequently rebated Mitsubishi units.

Here you can see the larger units have more capacity at all temperatures. But at the lowest temperatures, that difference becomes smaller, so you may not need to oversize the unit for the rest of the year. Again, compare the maximum capacity at design temperature with the load at design temperature.

Total Capacity of Most Commonly Rebated Daikin Units



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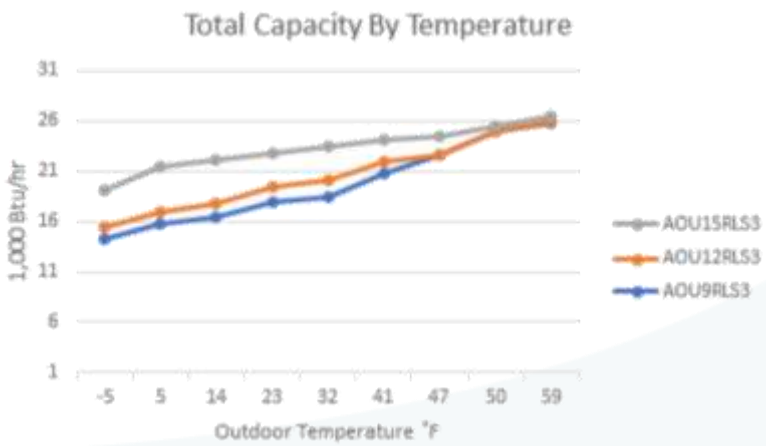
6. Sizing - 4

Moving on to Daikin (Die - kin) units, we see a similar trend where the difference between the biggest capacity and the smaller capacity gets much narrower as you get to lower temperatures

Total Capacity of Most Commonly Rebated Fujitsu Units



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6. Sizing - 5

Moving on to the Fu - jit - su units, you can see that a couple of them, the 9s and the 12s, have very similar capacity even though their name would suggest that one has a third more capacity than the other.

That's not actually the case, so you might be better off with a 9 than a 12. And, as you can see from this graph, the difference results in just a marginal reduction of capacity at negative 5 degrees Fahrenheit.

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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

- Maximize space that can be heated/cooled—big, open spaces
- Locate in frequently used spaces to save the most energy and money
- Consider impact of staircases—heat rises, cool falls

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7. Placement - 1

Here are some of the criteria to consider.

First, try to maximize the space that can be heated or cooled. You're looking for big, open spaces. That will increase the cost-effectiveness of the heat pump installation because more of the heat provided by the whole-house system will be offset.

Likewise, putting the heat pump in the most frequently used room can help homeowners save the most energy and money.

However you want to be careful about the indoor unit's interaction with existing thermostats. We'll talk about that more in a moment.

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
- Prioritize
  - Look first for wall unit locations
  - Then floor units
  - Then ceiling cassettes
  - Then ducted unit
- 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)

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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.

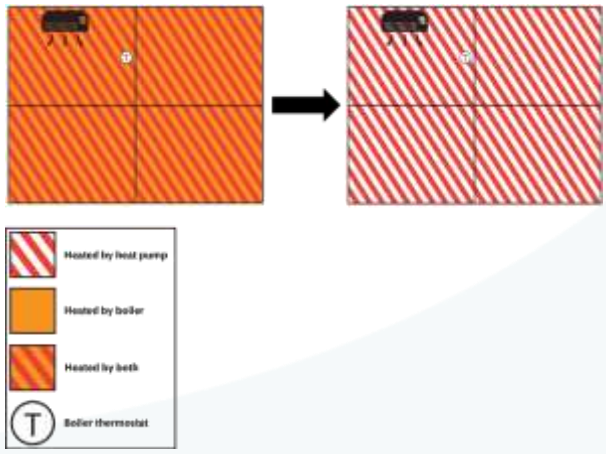
Picking spots that are easy to wire and plumb also makes sense. It's easiest to run line-set through spaces like a closet, unfinished stairwell, or garage. You may find your customers are happiest if you avoid putting condensate pumps in bedrooms, because they can make noise during the air conditioning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

Thermostat Placement: Heat Pump/Boiler Zone Overlap

The Ideal Case

If heat pump can heat the entire boiler zone

1. Set heat pump for comfort
2. Set boiler lower to use only as backup



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7. Placement - 3

Now let's address heat pump placement in relation to existing thermostats for the whole-house heating system.

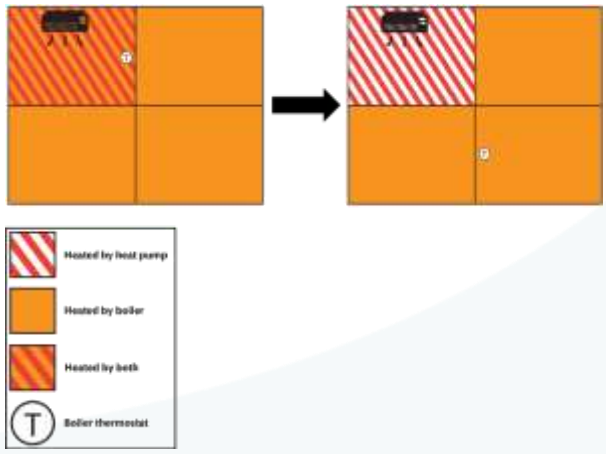
If a heat pump zone and the boiler zone overlap completely, meaning the heat pump can heat the **entire zone** that the boiler heats, then you're in great shape. The homeowner will just need to set the heat pump for comfort, and set the boiler down so that it will only come on if the heat pump can't meet the heating demand.

Heat Pump/Boiler Overlap:

A More Challenging Case

If heat pump reaches boiler thermostat, but can't heat entire boiler zone, create "2 zones" by

1. Moving boiler thermostat out of heat pump range and
2. Closing radiators/vents within heat pump range.



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7. Placement - 4

This next slide talks about a more challenging installation.

If the heat pump zone includes the boiler thermostat, but it can't heat the entire boiler zone, that may create competition between the central boiler and the heat pump. To maximize the savings and effectiveness of the heat pump, we recommend trying to create two separate zones.

First, move the boiler thermostat out of the heat pump zone. Then, in the area where the heat pump can reach, try to disable or minimize heat from the central boiler or furnace.

This might mean closing dampers on the radiator or closing furnace ducts. This lets the heat pump heat one zone and the boiler or furnace heat the other, so there's no conflict.

Line Set Placement

GOOD

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

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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.)

BAD

GOOD

efficiency MAINE

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

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7. Placement - 7

Another consideration for line-set placement is protection of the outdoor unit.

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 other hazards. The unit shown on the right is a protected line-set -- with a roof and a cover.

There are a couple other unrelated problems in the picture. On the left you can see the one unit is blowing its exhaust into the other's intake, which is not ideal. You can also see that it's 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

★ Efficiency Maine Installation Requirements Checklist

7. Placement - 8

One of the requirements of our Installation Checklist is to keep line-sets vertical or horizontal, not diagonal.

Line Set Placement

Consolidate lines into single line cover if possible

BAD

GOOD

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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 is more aesthetically pleasing for the customer.

Line Set Placement

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

BAD

GOOD

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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 this case, on the left, you see two line-sets a few inches away from each other and a third a couple 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

efficiency MAINE

7. Placement - 11

Another good practice is to try to avoid installation on visible sides of the house.

Here on the left you can see a home needing a heat pump on the far end of the house. Instead of putting the heat pump on the end, 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 greater than or equal to 18" above ground unless protected from the 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 off 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

★ Efficiency Maine Installation Requirements Checklist

7. Placement - 13

Unobstructed airflow is critical. Placement locations should avoid shrubs, risks of snow drifts or any structures that may block airflow.

This is a requirement of the Checklist -- customers may be tempted to obscure units for aesthetic reasons but the placement must have access to unobstructed air flow. On the left is an example of two units obstructing each other.

Outdoor Unit Placement

★ Does not interfere with walkway, porch, window or door – avoid icy patches on walkways

BAD

BAD

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★ Efficiency Maine Installation Requirements Checklist

7. Placement - 14

Another installation requirement is the outdoor unit must not interfere with a walkway, porch, window, or door. Placement should also consider how to prevent icy patches on walkways.

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

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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

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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

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7. Placement - 17

Lastly, consider the noise impact of the outdoor unit when choosing a location. You can reduce the noise the unit will generate by installing it at the base of the wall or at the corner of the house rather than the middle of the wall.

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9. Operation
10. Other Considerations

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.

Next 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

GOOD

★ Efficiency Maine Installation Requirements Checklist

8. Installation - 2

The next step is to make sure to observe all service clearances. This is also a requirement on our Checklist.

Outdoor Unit Installation

★ Unit must be level and plum

BAD

GOOD

★ Efficiency Maine Installation Requirements Checklist

8. Installation - 3

On the exterior, we also need to make sure that the outdoor unit is level and plumb. This is also an installation requirement.

Outdoor Unit Installation

★ Outdoor unit and line set protected from falling snow if below metal roof

BAD

GOOD

GOOD — If Under a Metal Roof

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★ Efficiency Maine Installation Requirements Checklist

8. Installation - 4

Installers must also ensure the outdoor unit and line-sets are protected from falling snow, especially if it's below a metal roof.

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 wreak havoc on 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 of our Checklist.

Outdoor Unit Installation

If ground mounted, there must be a stable base.

BAD

GOOD

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8. Installation - 5

If the unit is ground mounted, it needs to be on a stable base. As seen here, a concrete pad is a better option than a stand directly on the ground.

Outdoor Unit Mounting Options

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

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5. Selection - 6

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

There are three general approaches.

Wall mounts are effective because they keep the units up off the ground, away from rakes and 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 better option is a ground stand, which can minimize noise. However, there are drawbacks to a ground stand. Depending on how they're installed, they may be susceptible to frost heaves.

One thing to consider if you've put in a ground stand is a ground stand with adjustable legs. In the spring, if you see that the unit has shifted due to frost heaves, you can adjust the stand and get the unit level again.

The best bracket is what we've shown here, a foundation bracket, which bolts onto the foundation of the house. It gets the unit off the ground and avoids 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

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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 quantity per manufacturer guidelines
- Purged with nitrogen, pressure tested and evacuated per manufacturer's instructions
- Line set purged with nitrogen, pressure tested (e.g. 550 psi) and evacuated with pump per manufacturer's instructions
- Flare connections tightened using manufacturer's torque specification

★ Efficiency Maine Installation Requirements Checklist

Recommendations

- Use bending tool if necessary to avoid kinks when bending
- Use torque wrenches for flare fittings
- Crimp, tape, or cap loose ends of line set to keep clean until final connection
- Line set preparation, see next slide

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8. Installation - 8

Moving on to line-set installation, as you know, line-set installation requirements vary depending on manufacturer.

On our Installation Requirements Checklist, we ask that you specify the lengths and refrigerant quantity that you used for the installation and how it compares to the manufacturer guidelines.

We also require that the line-set be purged with nitrogen, pressure tested, and evacuated according to the manufacturer's instructions.

In addition to these requirements, Efficiency Maine has compiled several recommendations, listed here, based on conversations with manufacturers, distributors and installers.

Line Set Installation Best Practices: Triple Evacuation Procedure

SEQUENCE	ACTION	PRESSURE	DURATION
1	Flush with nitrogen to blast out any debris and to dry lines		
2	Pressurize with nitrogen	500-600 PSIG	20-60 min with no drop on pressure gauge
3	Evacuate system	4,000 microns of mercury	15 minutes
4	Break vacuum with nitrogen	2-3 PSIG	
5	Evacuate system	1,500 microns of mercury	20 minutes
6	Break vacuum with nitrogen	2-3 PSIG	
7	Evacuate system	500 microns of mercury	60 minutes

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Continuing with line-set installation best practices, we encourage all installers to follow the triple evacuation procedure to ensure proper functioning of the system.

Torque Chart

Remember to always follow your manufacturer's torque requirements.

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

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Please follow manufacturer guidelines regarding the tightening of flare connections. We've included the torque charts from major manufacturers here.

Line Set Installation

★ Visible line sets in line set cover with transition and termination fittings

BAD

GOOD

★ Efficiency Maine Installation Requirements Checklist

8. Installation - 11

Another Efficiency Maine requirement is that visible line-sets be inside of line-set covers with transition and termination fittings.

On the left, you can see that there are no termination fittings. The termination fittings, which you see on the right, secure the cover to the house. These fittings look good aesthetically 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

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★ Efficiency Maine Installation Requirements Checklist

8. Installation - 12

The Efficiency Maine Checklist requires that insulation cover the full length of the-line-sets and there should be 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, and created a point of energy loss. In the right-hand photo you can see the installer did an excellent job of restoring the insulation cover and covering all the copper.

Line Set Installation

★ Floor/wall/ceiling penetrations sealed

BAD

GOOD

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★ 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, varmints, and insects to come in next to that line-set.

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

Line Set Installation

The full length of the line set should be supported

BAD

GOOD

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8. Installation - 14

Another best practice we've talked about is protecting a line-set from falling ice if it's below a metal roof. 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.

Line Set Placement

Match color of house

BAD

GOOD

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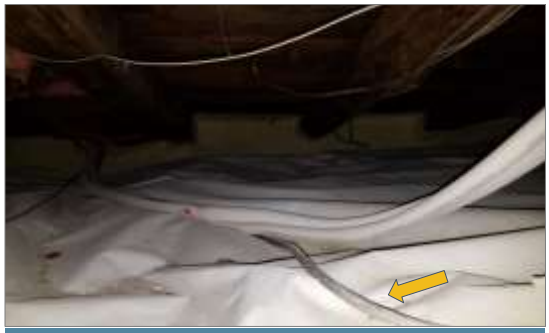
7. Placement - 15

When possible, try to match the color of the line-set cover to the house. In the picture on the right, the line-set cover blends better than the picture on the left.

Condensate Line Installation

Install condensate line without dips or traps. Use rigid pipe (not flexible tubing) for long, low-slope runs.



BAD

GOOD

★ Efficiency Maine Installation Requirements Checklist

8. Installation - 16

Remember to install condensate lines without dips or traps. This avoids having condensate back up into the indoor unit. Indeed, with even a small dip, water can back up multiple feet in the line. When possible, use rigid pipe.

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

Electrical Connections Installation

Disconnect box wiring shock risk reduced by lock, strap tie and/or box that provides other means of protection.

★ Electrical work performed by licensed electrician or as authorized by Electrician's Board.

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★ Efficiency Maine Installation Requirements Checklist

8. Installation - 17

Lastly let's cover the installation of the electrical connection. Make sure the disconnect box's wiring is secured with a lock, strap tie, or a box that provides some means of protection. This work must be done by a licensed electrician.

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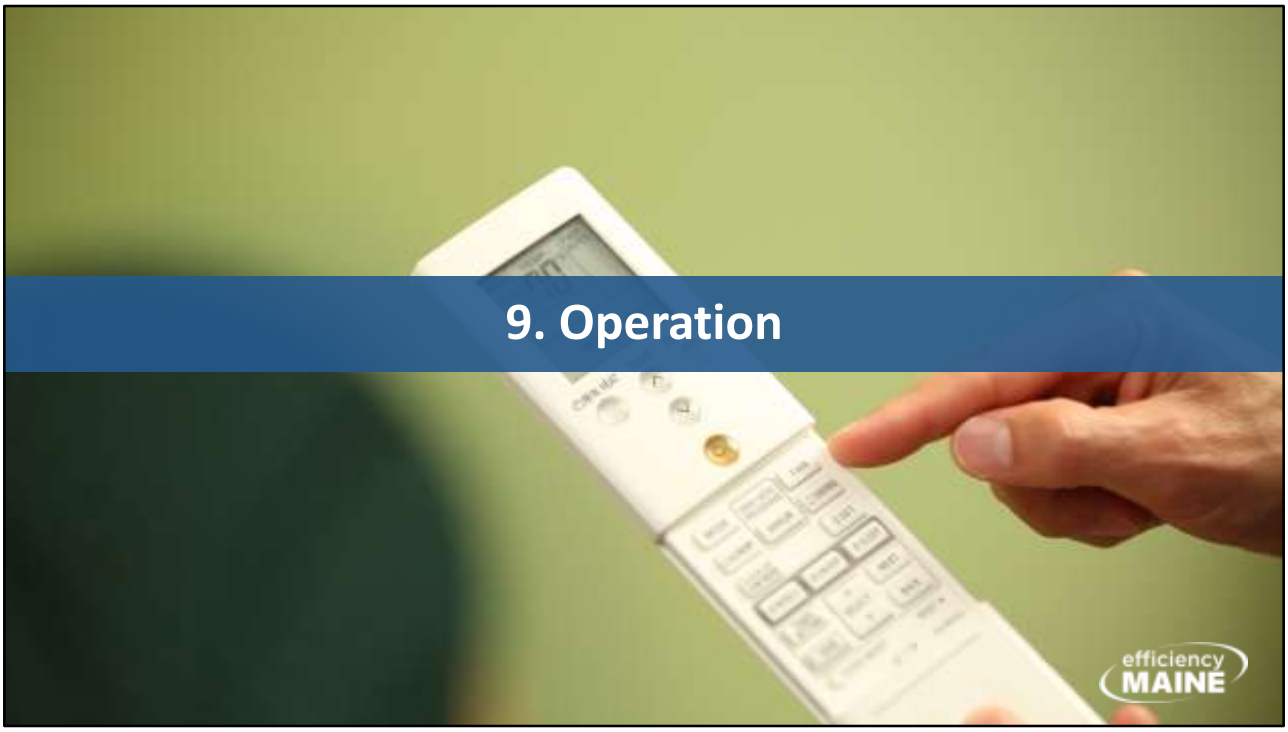
This concludes the section on Installation. Click the “Next Lesson” button to move on to heat pump operation.



Let’s review heat pump operation.

Operation and Getting the Most from a Heat Pump

- ★ Providing user training and sharing *Ductless Heat Pump User Tips* brochure is required for rebate processing
- Why are good operation and the tips important?
  - Homeowners who follow Efficiency Maine's ductless heat pump tips can achieve the greatest savings from their heat pump
  - Savings can be negatively impacted by not following tips
  - **Ensure customer satisfaction** and reduce callbacks by educating customers

★ 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 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 tips now and why we include them. **Reviewing these best practices can limit call backs and customer dissatisfaction.** And as we discussed earlier, using the heat pump correctly can help customers save energy and increase savings.

Indoor Unit - The Basics

Installers should ensure customers can:

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

efficiency MAINE ★ 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.

Outdoor Unit — The Basics

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 (will self-defrost)

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9. Operation - 3

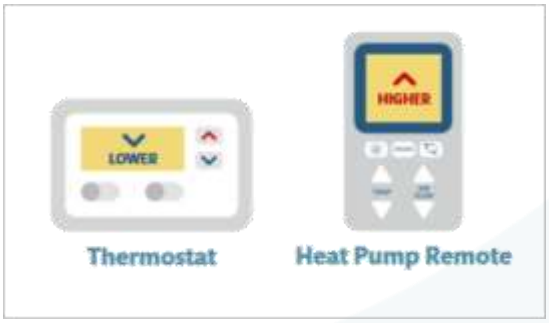
Another important tip to share with customers is the need to keep the outdoor unit clear from obstructions. We recommend that outdoor units for heat pumps, in general, be professionally inspected every year and cleaned as necessary.

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.

User Tips: Temperature and Thermostat

- **Set the Thermostat for Comfort**
  - Set for the temperature that makes the house comfortable
  - This may be higher than the customer is used to
- **Prioritize Your Heat Pump**
  - Set the heat pump temperature higher than the furnace to ensure the heat pump, and not the furnace, is providing heat



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9. Operation - 4

The next user tip is about temperature and thermostat use.

We recommend that customers set their thermostat for their comfort. This temperature may be higher than what they are used to with their boiler or furnace. For instance, someone who may set their furnace to 68 degrees Fahrenheit may find that this is similar to setting their heat pump to 70 degrees.

At Efficiency Maine, we encourage customers not to worry about the number, just set it for comfort.

And as we discussed in the siting section, we also recommend that to get maximum savings customers should prioritize their heat pump. Meaning use the heat pump whenever you can and only use the furnace or boiler as needed. Setting the heat pump temperature higher than the whole-house system will help.

User Tip: Minimize Changes to the Temperature Settings

- As described previously in the "Heat Pump Myths and Facts," heat pumps work best when maintaining a steady temperature
- "Set it and forget it"

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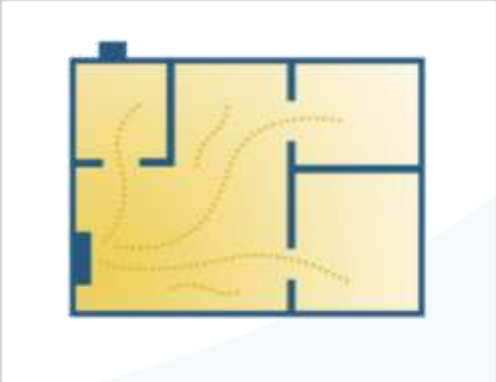
9. Operation - 5

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 see. 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.

User Tip: Maximize the Heating Zone

- Maximize the heating zone for the biggest energy and financial savings
- If heating multiple rooms, be sure to open doors between the heat pump and any rooms you'd like to heat
- If you are trying to heat only the room where the heat pump is installed, close the doors.



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The next tip you can share is to maximize the heating zone by opening doors between the heat pump room and any other rooms that the customer may want to heat.

Of course, they should close doors to any rooms they don't want to heat.

User Tip: Avoid Temperature Auto Mode

- "Auto Temperature" mode automatically switches between heating and cooling based on indoor temperature.
- System could start heating on a cool summer night or cooling on a sunny winter afternoon.
- Set the heat pump mode to "Heat" in the winter and "Cool" in the summer.

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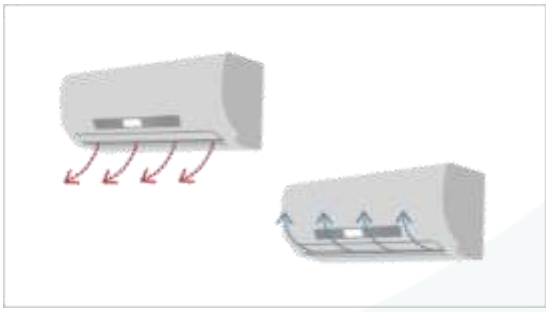
9. Operation - 7

We suggest avoiding the "Temperature auto-mode," which may not be intuitive to a new heat pump user. This is an important tip to share with homeowners because a system put in auto mode may accidentally 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



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9. Operation - 8

On the other hand, your customers may want to start off with “Auto Fan” and see if that works for their space.

If that doesn't spread the heat far enough, they can adjust the fan’s speed up or down according to their needs. We have also found that helping customers with air flow direction can ensure heat pump satisfaction.

Aiming warm air directly at an occupant can actually make them feel chilled, so generally we would direct warm air away from occupants and cool air at occupants.

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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

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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. That may prevent leaking when it cools. Another option is to drain the boiler and distribution system if they are not going to be used.

Another consideration is how to prevent frozen pipes. Some boilers unintentionally heat the basement, keeping pipes above freezing. If the boiler is shut off, the pipes won't be heated and can freeze.

One solution for this is to consider insulating the basement walls between the pipe and the outdoors. But be mindful of where the pipes are in relation to the insulated basement walls -- don't leave the pipes on the outside of the insulation, which might make them more likely to freeze. Another option is to consider adding some antifreeze into the distribution system.

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Thank you for your attention during this training and thanks for your good work helping people in Maine save energy every day.

If we can be of help, please give us a call at (866) 376-2463 or visit our website, Efficiencymaine.com.