AIR SOURCE HEAT PUMP DECISION MATRIX AND SYSTEM DESIGN GUIDE

Who: Heat pump installers | **Why:** Learn the process to design a layout to best fit your projects

In this guide, you will learn how to choose the most suitable type of heat pump system according to the specific requirements of your project. By following the guidelines, you can ensure that the heat pump meets the needs of the home and delivers comfort efficiently. The guide covers the customer's objectives, designing the system layout, correct sizing, and equipment selection.

This guide helps answer the questions of the heat pump design process:

- Will the heat pump cover the whole-home or part of the home?
- Should the heat pump be sized to be the lone source of heating or supplement an existing legacy system?
- Which type of heat pump best fits the home?

PARTIAL OR WHOLE-HOME SYSTEMS?

When designing a heat pump system for your home, you have two options - a partial or whole home system. A whole home system is designed to be the primary heat source for your entire home, with the option of auxiliary heat if needed. On the other hand, a partial load system will only cover part of the load and can be used to supplement an existing heating setup. This is an important decision when considering a home's heat pump system.

PARTIAL SYSTEM

Partial systems are a great solution for homeowners who want to reduce their carbon footprint, heat and cool a new addition, electrify incrementally, add an efficient cooling system, or supplement an existing legacy system.

Benefits of partial:

- ✓ Low installation cost
- ✓ Potential capability to cover all heating or cooling for mild temperatures
- ✓ Can cover all cooling in heating driven climates
- ✓ Reduces carbon production of legacy system

WHOLE-HOME SYSTEM

A whole-home system is the best choice for homeowners who want to reduce their carbon footprint, replace an outdated or inefficient legacy system, enjoy year-round efficient heating and cooling while reducing maintenance costs, and maximize incentives.

Benefits of whole home:

- ✓ Only need to maintain and upkeep one system
- ✓ Pathway to full electrification
- ✓ Greatly reduced carbon footprint
- ✓ High efficiency heating and cooling

PARTIAL VS. WHOLE-HOME SYSTEMS ENERGY SAVINGS

Partial and whole-home heat pump systems can yield energy savings when correctly sized and installed.

A partial system can reduce energy use during mild heating conditions, covering heating and cooling. In peak seasons, it's efficient but not sized for whole-home temperature control. The legacy system handles the remaining load, therefore the coordination between the two is crucial to avoid inefficiency from overcapacity.

A whole-home system that is sized and installed correctly should operate efficiently and save energy throughout the entire year. This system will cover all heating and cooling needs of the home without need for a supplementary system. Installing a whole home system can reduce energy consumption, operating costs, and the carbon footprint of a home. Savings depend on the size of the home, location, existing HVAC equipment, fuel prices, and electric prices.

A high-efficiency air source heat pump can be 300% efficient, meaning three times the heat is produced for every unit of electricity used.

WHEN TO REPLACE AN INEFFICIENT LEGACY HEATING SYSTEM

If a whole-home heat pump system can cover all heating and cooling needs, the legacy heating system may be decommissioned. Consider installation requirements, homeowners' priorities, and the condition of the legacy system.

Remaining Lifespan of the Legacy System
The closer the legacy system is to the expected end of its lifespan, the less value there is to retaining it.

Efficiency of the Legacy System
Maintaining a more efficient legacy heating system offers increased cost-saving benefits in terms of operating expenses. Compare the efficiency of the legacy system to the efficiency of a new heat pump. New ASHP's remain efficient even in sub-freezing temperatures, potentially making them cost-effective across all temperature ranges.

Ductwork
If the new heat pump will use the existing ductwork, the legacy system may need to be decommissioned to make room for the new air equipment.

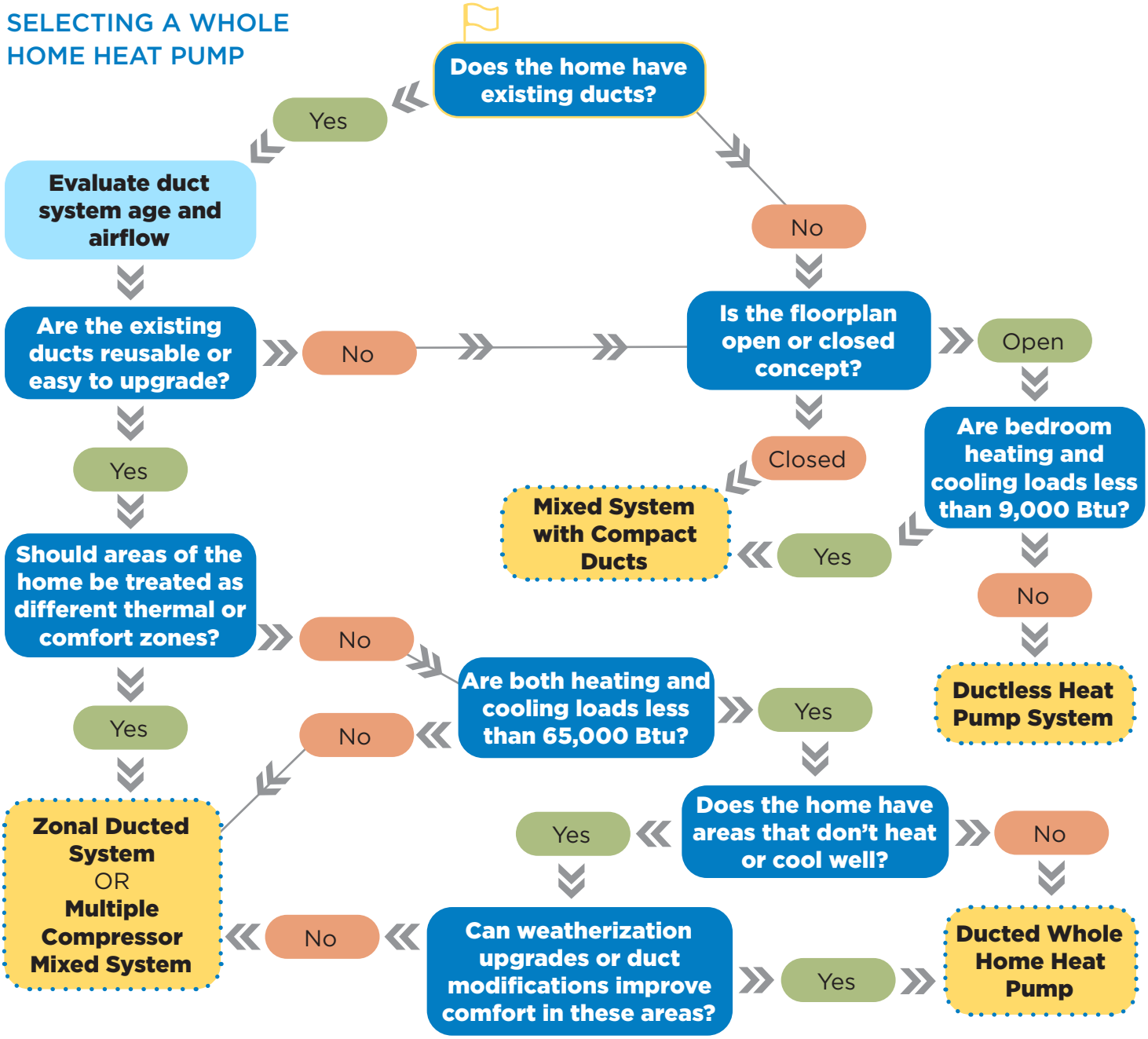
Electrification
If the homeowner wants to pursue full electrification, retaining a fossil fuel heating system would not be compatible with their goals.

Redundancy
Retaining the legacy system provides redundancy in case a system fails. Note that legacy furnaces and boilers will NOT run during a power outage without a backup power source such as batteries or a generator. If power outages are the concern, ensure the system runs without electricity or consider connecting the generator to the heat pump instead.

Maintenance
Decommissioning the legacy system will eliminate the cost and logistics of having to maintain two separate systems that serve the same function.

Space Saving
Removing the legacy system may be preferable or necessary if there is limited space in the mechanical room of the house.

SELECTING A WHOLE HOME HEAT PUMP



HEAT PUMP CONFIGURATIONS

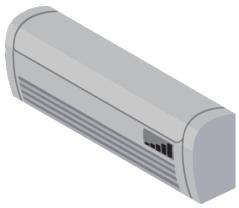
Heat pumps offer high customizability for optimal control of thermal zones. Heat pump systems can be configured with variations of ducted and ductless solutions. Interior units can be connected to the same or different compressors. To select the system that best fits the home, consider the home's thermal zones, exterior space, and installation costs.

A one-to-one system, or mini-split, is a single indoor unit connected to a single outdoor unit. The one-to-one design is useful for partial load installations, a house served by a single air handler, and to serve areas of the house which have substantially different thermal needs than other zones. Mini-split systems can decrease effects of oversizing as one heat pump may take primacy over heat pumps in the same zone. Multiple compressors lead to higher upfront costs and more exterior space needed.

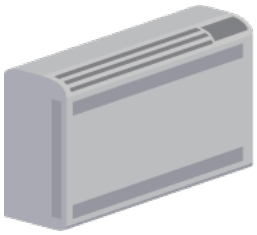
A multi-split system consists of one outdoor unit connected to more than one indoor unit. Compared to multiple one-to-one units, this design saves outdoor space and reduces redundancy of equipment. There can be efficiency losses for the multi-split layout if heads on the same outdoor unit serve spaces with very different thermal characteristics – for example - an upper floor and a finished basement.

Selecting a Ductless Unit Type

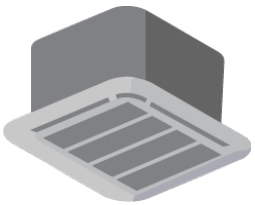
If you have concluded that a ductless system is right for the space, the next step is to decide which type of indoor unit fits best. Ductless heat pumps can be installed as a one-to-one system or a multi-split system with various types of indoor units.



Wall Mounts are popular due to low installation costs and space adaptability. They're easy to maintain if accessible to homeowners. For limited ceiling wall space or a discreet appearance, explore alternate options.



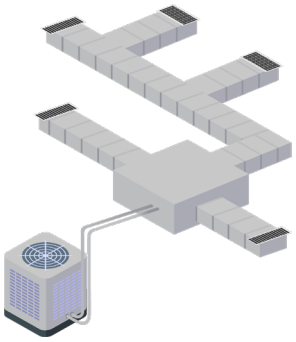
Floor Mounts offer easy maintenance access and suit those who can't reach high units. Ideal when wall space is low, they can be strategically hidden or integrated into the room's aesthetics. Clearance around the unit is necessary; if space is limited, explore other choices.



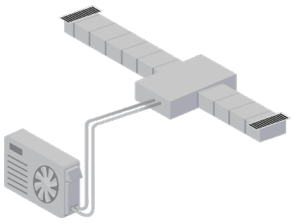
Ceiling Cassettes are the lowest profile and resemble a traditional air vent. They are a great choice for a homeowner who prefers to hide their heating and cooling equipment. This low-profile look comes at a higher installation cost. They can also be difficult to reach to clean the filter. If the room has vaulted ceilings or no space to run refrigerant lines above the ceiling, consider opting for another choice.

Selecting a Ducted System

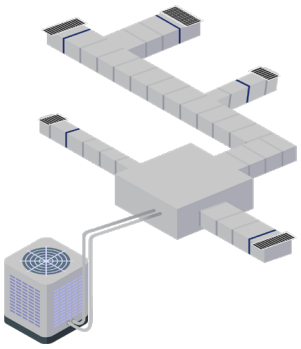
Once you have come to the conclusion that a ducted system is right for the space, the next step is to decide which type of ducted system to install.



Traditional Ducted are cabinet-style air handler systems provide whole-house or large zone supply. They're ideal for new construction, houses with existing ductwork, spacious attics/basements, or partitioned spaces with small zonal loads. Existing ducts should be evaluated before reusing. Installing new ducts is comparatively expensive to installing a ductless system.



Compact Ducted units, also known as slim or concealed ducted, serve a few rooms instead of an entire floor or house. They suit homes without ductwork and rooms with small loads unfit for ductless units. For instance, a 9,000 BTU compact ducted unit is more efficient than two separate 9,000 BTU ductless heads for rooms needing 4,000 and 5,000 BTUs. These units are great for homes without ducts, offering traditional vent appearance. They fit above closets, in garages, crawl spaces, and areas where traditional ducts wouldn't.



Zonal Ducted systems operate similarly to other ducted systems but have the ability to serve multiple thermal zones. They can serve the needs of multiple zones by controlling the airflow through the use of dampers. These systems fit well in a home that is highly partitioned and has complicated needs.

Can the Ductwork be Re-used?

Before equipment selection, any ductwork should be checked for leakage and airflow to make sure that it will be sufficient for the heat pump. Ductwork retrofits may be necessary, including additional registers, insulation, and upsizing duct runs. If the previous ducted system was heating or cooling only, an additional return may be needed to increase circulation. If a cost effective retrofit of the ductwork is not possible, consider other distribution methods.

SIZING AND EQUIPMENT SELECTION

Once you have the general layout of the system set, you can determine the specific loads of the zones and capacities of the equipment that will serve them.

Load Calculations: Accurate load calculations are critical to ensure that the heat pump will maintain comfort efficiently throughout the year. Use an ACCA Manual J approved software for your load calculations. **Be sure that the design temperatures and measurements of each zone of the house are accurate**. Refrain from adding unnecessary loads or artificially inflating the calculations as the Manual J is conservative in its calculations and further inflating the calculations may lead to oversizing. **Sizing the heat pumps to fit the zone they will be heating and cooling is important as it is possible to over or undersize part of the system even if the system is sized correctly overall**. Gather as much information as is practical about the insulation, windows, infiltration, and compass orientation of the house. Each of these building features will have a significant impact on the calculated load.

Equipment Selection: Once the Manual J is complete, use ACCA Manual S to select the specific equipment that matches the desired layout. **Manual S ensures that the equipment can meet the heating and cooling load of the house, move the required volume of air through the ducts, and manage the latent load to dehumidify the air in the cooling season**. Manual S will drive the user to size for cooling then add supplemental heating if needed. In heating dominated climates this will force the use of fossil fuels or inefficient electric resistance. **For heating dominated climates, size the heat pump to meet the heating design load when designing to be the sole source of heating**. Then use the manufacturer's performance data to confirm the heat pump has sufficient latent removal or will modulate low enough to manage dehumidification needs and if not, add supplemental dehumidification to the home. Supplemental dehumidification will be will be most necessary in climates with prolonged high humidity at moderate temperatures.

Supplemental Heat: Supplemental heat is not recommended to always be installed with a heat pump, but can be installed to provide heat during defrost cycles or sustained extreme cold that is lower than typical for the area. It is recommended that the supplemental heat be sized to a smaller capacity to only supplement the heat pump. If larger supplemental heat is installed, it should be programmed to engage in small incremental stages as needed. These strategies reduce the energy waste of the less efficient heating system.

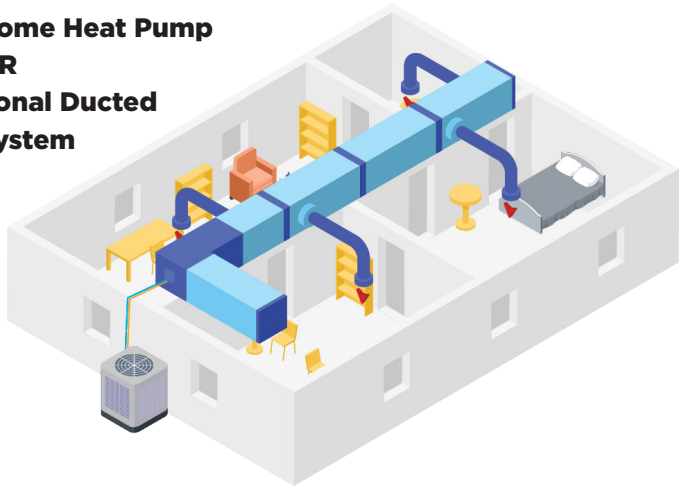
SYSTEM LAYOUT

After determining which type of system best fits the needs of the home and sizing and selecting equipment, it is important to determine the best layout for the system.

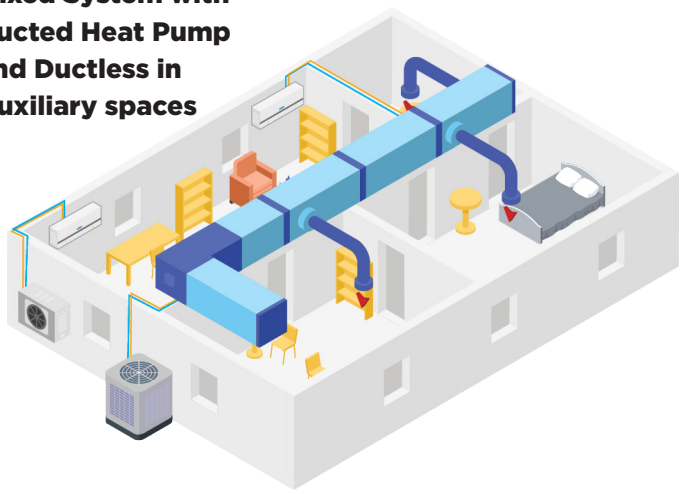
When laying out a system, consider which rooms will be heated and cooled similarly. Block these rooms into zones that will be conditioned by the same heat pump. Consider putting rooms that are used less than the rest of the home, like guest bedrooms, offices, or gyms, into their own zone. This will allow the homeowner to save money by not conditioning these rooms unless needed.

Use the example layouts on the next page to get started laying out your system.

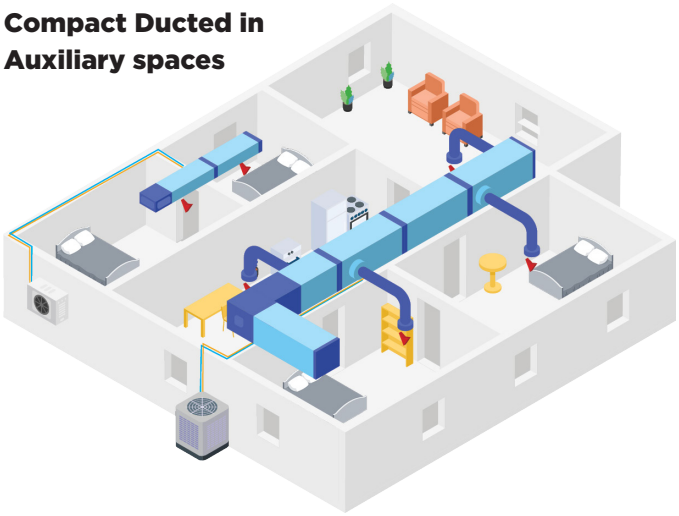
Ducted Whole Home Heat Pump OR Zonal Ducted System



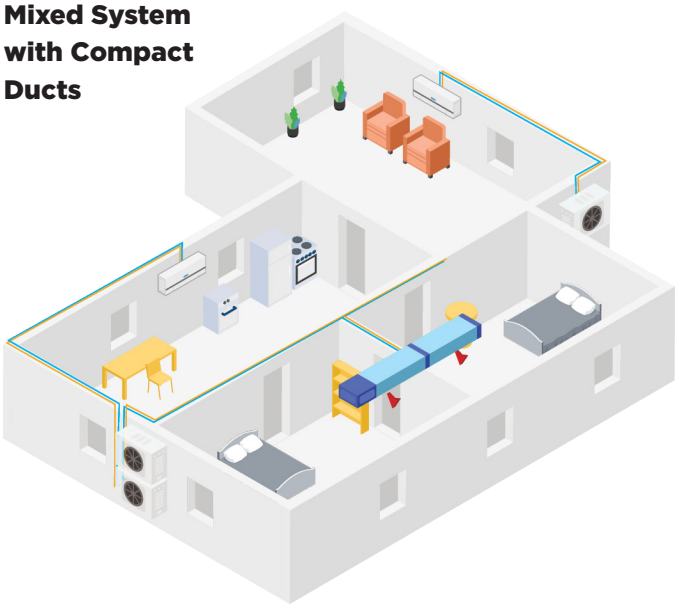
Mixed System with Ducted Heat Pump and Ductless in Auxiliary spaces



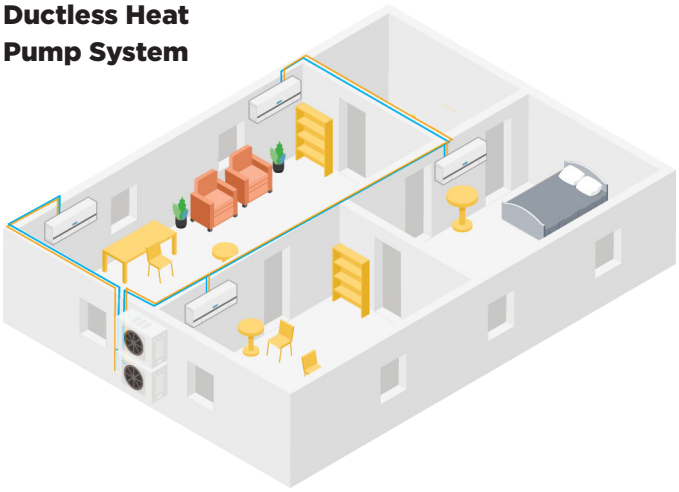
Mixed System with Ducted Heat Pump and Compact Ducted in Auxiliary spaces



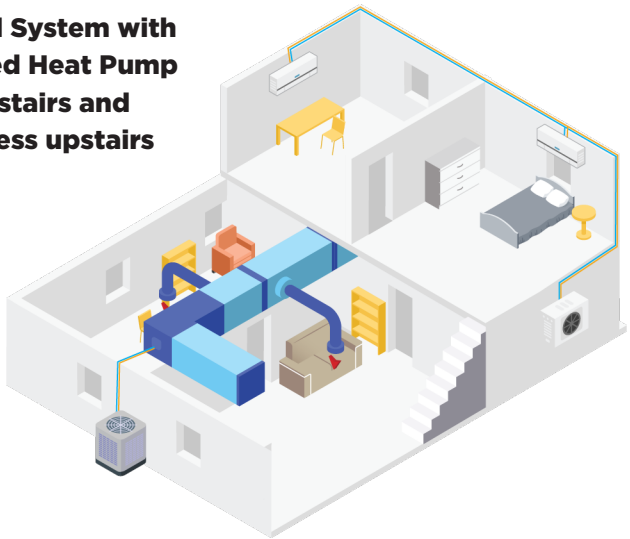
Mixed System with Compact Ducts



Ductless Heat Pump System



Mixed System with Ducted Heat Pump downstairs and Ductless upstairs



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