

- **Reviewing Key Safety Measures for Mobile Home HVAC Work**
Reviewing Key Safety Measures for Mobile Home HVAC Work Understanding PPE Guidelines for Mobile Home Furnace Repair Following OSHA Standards During Mobile Home AC Installations Noting Electrical Hazard Precautions in Mobile Home HVAC Projects Planning Lockout Procedures for Mobile Home Heating Maintenance Checking for Proper Ventilation in Mobile Home HVAC Crawl Spaces Confirming Compliance with HUD Requirements for Mobile Home Ducts Conducting On Site Safety Assessments Before Mobile Home AC Repairs Checking Gas Line Integrity in Mobile Home Heating Systems Identifying Combustion Clearance Issues in Mobile Home Furnaces Monitoring Air Quality Factors During Mobile Home HVAC Upkeep Coordinating Exit Strategies for Emergencies in Mobile Home HVAC Work
- **Identifying Warning Signs of Outdated Components**
Identifying Warning Signs of Outdated Components Converting Older Units to High Efficiency Models Examining Duct Layout for Better Distribution Adjusting Equipment Size to Fit Modern Needs Evaluating Newer Options to Replace Electric Heaters Implementing Airflow Balancing Techniques Overcoming Physical Constraints in Legacy Structures Transitioning to Improved Refrigerants for Compliance Strengthening Insulation to Enhance Performance Matching Compatibility of Controls and Existing Wiring Coordinating Expert Consultations for Complex Projects Planning Timelines for Effective System Upgrades
- **About Us**



Efficient duct layout is a critical component of any well-functioning HVAC system, yet it often goes unnoticed by those who benefit from its operation. The importance of an optimized duct layout cannot be overstated when considering air distribution within residential, commercial, or industrial spaces. A well-designed ductwork system ensures that conditioned air reaches all intended areas with minimal loss, maintaining comfort and energy efficiency. As we examine the intricacies of duct layout for better distribution, several key factors come into play.

Regular maintenance can prolong the life of an HVAC system in a mobile home **mobile home hvac replacement** ventilation.

First and foremost, efficient duct layout contributes significantly to energy conservation. Poorly designed ducts can lead to substantial energy losses as air escapes through leaks or travels unnecessarily long paths to reach its destination. This not only increases energy bills but also places additional strain on HVAC systems, shortening their lifespan and leading to more frequent repairs. By optimizing the layout of ducts-ensuring they are properly sealed and insulated-homeowners and businesses can enjoy reduced operational costs while also minimizing their carbon footprint.

Moreover, an effective duct design enhances indoor comfort levels. Inconsistent temperatures across different rooms can be frustrating and uncomfortable for occupants. An efficient duct layout considers factors such as room size, occupancy patterns, and natural airflow tendencies within the building to ensure even temperature distribution. This means no more hot spots in the summer or cold corners in the winter; every part of a building receives its fair share of conditioned air.

In addition to energy savings and comfort, proper duct design plays a vital role in maintaining indoor air quality (IAQ). Efficient layouts help prevent stagnant air pockets where dust, allergens, or pollutants might accumulate over time. By facilitating consistent airflow patterns throughout all rooms, contaminants are less likely to linger in one place and instead are filtered out through regular circulation processes.

Achieving an optimal duct layout requires careful planning during the initial design phase of a building project or during retrofitting existing systems. Collaborating with experienced HVAC professionals who understand both the science behind airflow dynamics and practical installation techniques is essential. They can conduct comprehensive load calculations to determine precise airflow requirements for each space, thereby guiding decisions regarding appropriate duct sizes and materials.

In conclusion, examining the importance of efficient duct layout reveals its crucial role in achieving better air distribution throughout any built environment. By focusing on optimizing this often-overlooked aspect of HVAC systems-ensuring airtight seals, strategic placement based on calculated demands-and working closely with knowledgeable professionals during implementation stages-we not only enhance overall energy efficiency but also improve occupant comfort levels while safeguarding indoor air quality standards simultaneously.

Common Hazards Associated with Mobile Home HVAC Systems —

- Importance of Safety in Mobile Home HVAC Work
- Common Hazards Associated with Mobile Home HVAC Systems
- Essential Safety Gear and Equipment for Technicians
- Proper Procedures for Handling Refrigerants and Chemicals
- Electrical Safety Protocols for Mobile Home HVAC Work
- Best Practices for Ensuring Structural Integrity During Installation and Maintenance

Examining duct layout for better distribution in mobile homes brings to light a series of common challenges that homeowners frequently face. Mobile homes, known for their compact and efficient use of space, present unique difficulties in ensuring effective heating and cooling through ductwork systems. Understanding these challenges is crucial for improving air distribution and maintaining comfortable living conditions.

One primary challenge involves the limited space available for duct installation. Unlike traditional homes, mobile homes often have less room to accommodate large or complex duct systems. This constraint can lead to inadequate airflow if the ducts are not properly designed or installed. The compact nature of mobile homes necessitates careful planning to ensure that ducts are appropriately sized and strategically placed to cover all areas equally without compromising efficiency.

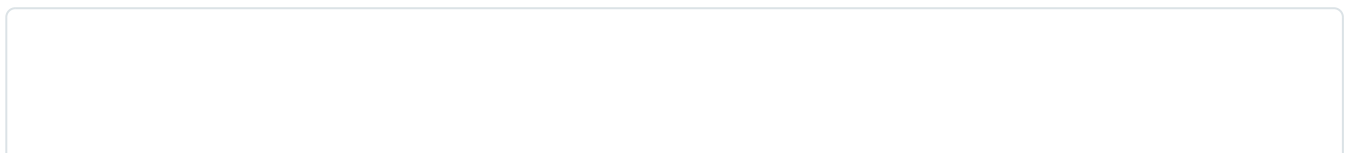
Another significant issue is the quality of materials used in mobile home ductwork. Often, manufacturers opt for thinner materials that may lack the durability and insulation properties needed for optimal performance. Over time, these materials can deteriorate, leading to leaks or blockages that disrupt airflow distribution. Homeowners must be vigilant about maintenance and consider upgrading to more robust materials if they encounter persistent issues.

The design of the duct layout itself can also pose challenges. Poorly planned layouts might result in uneven temperature distribution throughout the home, with some rooms receiving more air than others. This imbalance can create hotspots or cold zones, making it difficult to maintain a uniform climate inside the mobile home. To address this problem, homeowners should work with HVAC professionals who understand the nuances of mobile home construction and can devise a layout that promotes balanced airflow.

Moreover, accessibility for repairs and maintenance is often restricted in mobile home ductwork systems. Ducts are typically located beneath floors or within narrow spaces that are hard to reach without specialized tools or professional assistance. This limitation means regular inspections are essential but also challenging to perform thoroughly by homeowners themselves.

Finally, energy efficiency remains a critical concern as poorly designed duct systems can lead to significant energy losses. Leaks or gaps in connections allow conditioned air to escape before reaching its intended destination, driving up utility costs while reducing comfort levels within the home.

In conclusion, examining duct layout for better distribution unveils several common challenges faced by mobile homeowners: constrained space availability, subpar material quality, ineffective design planning leading to uneven temperatures across different rooms; limited accessibility hindering repair efforts; coupled with potential inefficiencies resulting from poorly constructed systems causing increased energy consumption rates overall-all underscoring why proactive measures such as engaging experts proficiently knowledgeable about specific needs associated exclusively related towards optimizing every aspect involved regarding achieving successfully balanced ventilation outcomes remain imperative moving forward consistently over time toward attaining desired results effectively overall ultimately benefiting both occupants' comfort level alongside lowering operational expenditure simultaneously altogether efficiently indeed!



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Essential Safety Gear and Equipment for Technicians

Analyzing existing duct layouts in mobile homes is a critical task for ensuring efficient climate control and comfort. Mobile homes, with their unique design and construction, present distinct challenges and opportunities when it comes to heating, ventilation, and air conditioning (HVAC) systems. As we examine duct layouts in these settings, the primary focus is on achieving better air distribution throughout the space.

One of the key aspects of analyzing duct layouts is understanding the constraints inherent in mobile home designs. Unlike traditional houses that have ample space for ductwork within walls or ceilings, mobile homes typically have limited room for such installations. This often results in ducts being placed under flooring or through small cavities, which can lead to inefficiencies in air distribution if not carefully planned.

Examining existing duct systems involves assessing both the layout and condition of the ducts. Over time, ducts can develop leaks or blockages that impede airflow, leading to uneven distribution of warm or cool air. This not only affects comfort but also increases energy consumption as HVAC systems work harder to maintain desired temperatures.

Improving duct layout begins with a thorough inspection to identify any issues such as leaks or poorly insulated sections. Sealing leaks and insulating ducts can greatly enhance performance by ensuring more consistent temperature control throughout the home. Additionally, reconfiguring existing layouts may be necessary to optimize airflow paths and eliminate unnecessary bends or turns that can reduce efficiency.

Another aspect worth considering is the size and placement of vents. Properly sized vents strategically located throughout the home ensure that each area receives adequate airflow without overburdening certain sections while leaving others underserved. In some cases, adding additional vents or adjusting their positions might be required to achieve balanced distribution.

Moreover, technological advancements offer new opportunities for enhancing duct system performance. Smart HVAC solutions like zoned heating and cooling allow for more precise control over different areas within a mobile home. These systems utilize advanced sensors and controls to direct airflow where it's needed most based on occupancy patterns and individual preferences.

In conclusion, analyzing existing duct layouts in mobile homes is essential for improving air distribution efficiency and overall comfort. By addressing structural limitations with thoughtful planning and modern technology integration, homeowners can achieve significant improvements in energy efficiency while enjoying a more comfortable living environment year-round. As we continue exploring ways to optimize HVAC systems within these compact spaces, it becomes increasingly clear how crucial effective duct design is towards creating sustainable living solutions tailored specifically for mobile homes' unique needs.



Proper Procedures for Handling Refrigerants and Chemicals

In the realm of modern architecture and building engineering, duct design and placement hold a pivotal role in ensuring efficient heating, ventilation, and air conditioning (HVAC) systems. Examining duct layout for better distribution is not merely an exercise in technical precision but a crucial strategy for optimizing energy efficiency, indoor air quality, and overall comfort within buildings.

The primary goal of effective duct design is to ensure that conditioned air reaches its intended destinations with minimal loss. This requires a meticulous approach to planning and implementing ductwork that accommodates the unique architectural features of each building while also meeting the specific needs of its occupants. A well-conceived duct layout can significantly reduce energy consumption by minimizing resistance and leakage within the system. This is achieved through strategic placement, appropriate sizing, and careful consideration of materials used in constructing ducts.

One fundamental strategy for enhancing duct distribution involves minimizing the length and complexity of duct runs. By reducing the distance air must travel from the HVAC unit to various rooms, energy losses due to friction and heat transfer can be minimized. Moreover, shorter ducts are less prone to leaks, which can further improve system efficiency. When designing these layouts, it is essential to consider direct routes whenever possible while avoiding sharp bends that could impede airflow.

Another critical aspect of optimizing duct design lies in balancing airflow across different zones within a building. Properly sized ducts ensure that each area receives adequate air volume without overburdening any single part of the system. This balance not only enhances comfort levels by preventing hot or cold spots but also promotes uniform temperature distribution throughout the space.

Additionally, integrating advanced technologies such as variable air volume (VAV) systems can further optimize performance by allowing dynamic control over airflow based on real-time demand. These systems adjust the amount of supplied air according to changing occupancy patterns or environmental conditions, thereby conserving energy while maintaining desired indoor climates.

Effective insulation plays a vital role in preserving conditioned air temperatures during transit through ducts. High-quality insulation materials help prevent unnecessary heat gain or loss along the way—a factor particularly important when ducts pass through unconditioned spaces like attics or basements.

Moreover, emerging trends emphasize sustainable practices such as using environmentally friendly materials for constructing ducts or adopting smart controls that enhance operational efficiency even further-aligning with broader goals towards reducing carbon footprints associated with building operations.

In conclusion, examining duct layout for better distribution encompasses myriad strategies aimed at optimizing both functional performance and sustainability outcomes across diverse settings-from residential homes to large commercial complexes alike-underscoring its significance as an integral component within contemporary architectural endeavors striving towards more efficient built environments globally today!

Electrical Safety Protocols for Mobile Home HVAC Work

In the modern era of energy conservation, the design and layout of duct systems in buildings have emerged as critical factors influencing both energy efficiency and occupant comfort. The proper distribution of air through a well-designed duct layout can significantly optimize HVAC performance, reduce energy consumption, and enhance the overall indoor environment.

The primary role of ductwork is to transport conditioned air from heating, ventilation, and air conditioning (HVAC) systems to various parts of a building. However, the efficiency with which this task is accomplished depends heavily on how the ducts are arranged. A poorly designed duct system can lead to uneven temperatures across different rooms, increased energy usage due to leaks and pressure imbalances, and ultimately higher utility costs.

One of the most significant impacts of a well-planned duct layout is on energy efficiency. When ducts are improperly sized or configured, they can create resistance to airflow, forcing HVAC systems to work harder than necessary. This increased load not only consumes more energy but also accelerates wear and tear on system components. Conversely, an efficient duct layout minimizes friction loss by ensuring smooth transitions between different sections of the system and maintaining appropriate sizing relative to airflow demand. Sealing joints

properly and insulating ducts further prevent heat loss or gain as air travels through unconditioned spaces like attics or basements.

In addition to saving on energy costs, a strategic duct design enhances comfort levels within a building. Properly distributed air ensures consistent temperature regulation throughout all areas, preventing common issues such as hot spots or drafts that often plague inadequately planned systems. This balanced distribution also helps maintain optimal humidity levels and improves indoor air quality by facilitating better ventilation.

Moreover, advancements in technology have introduced tools such as computer-aided design (CAD) software that allow engineers to simulate airflow patterns before actual installation begins. These tools ensure that every bend or branch in the ductwork contributes positively toward achieving uniform climate control across all zones within a building.

Overall, examining duct layouts for better distribution is not merely about addressing immediate heating or cooling needs; it involves anticipating future demands and creating flexible solutions that adapt over time without compromising performance. As buildings strive towards net-zero energy goals amidst rising environmental concerns, attention to detail in designing efficient duct systems becomes indispensable.

Thus, investing time into planning an effective duct layout reaps long-term benefits by maximizing operational efficiency while simultaneously providing comfortable living conditions for occupants-demonstrating once again how thoughtful engineering plays an essential role in sustainable development practices worldwide.

Best Practices for Ensuring Structural Integrity During Installation and Maintenance

In recent years, the spotlight on energy efficiency and comfort within mobile homes has significantly intensified. One crucial aspect of this endeavor is the optimization of duct layouts to ensure better air distribution. Case studies focusing on successful duct layout improvements offer invaluable insights into how these adjustments can lead to enhanced living conditions.

Mobile homes, often characterized by their compact size and unique structural constraints, present distinct challenges when it comes to HVAC systems. Traditional ductwork designs frequently fail to provide uniform temperature control across all areas, leading to hot spots in summer and cold patches during winter. However, through innovative approaches and meticulous planning, several case studies have demonstrated remarkable outcomes in mitigating these issues.

One such case study conducted in a mobile home community in Florida exemplifies the transformative impact of improved duct layouts. The project began with a comprehensive analysis of existing systems, which revealed significant inefficiencies due to poorly routed ducts that led to uneven air distribution. By employing advanced simulation tools, engineers were able to redesign the ductwork with precision. The new layout featured shorter runs and strategically placed vents that facilitated even airflow throughout each unit.

Post-implementation results were striking: residents reported a marked improvement in indoor comfort levels—with consistent temperatures achieved in all rooms—alongside noticeable reductions in energy consumption. This was attributed not only to the optimized air distribution but also to the reduced workload on HVAC units, which no longer had to compensate for inadequate airflow.

Another compelling example hails from a mobile home park in Oregon where similar challenges were addressed through an innovative approach known as 'zoning'. By dividing each unit into distinct zones with individual thermostatic controls and dedicated duct routes, homeowners gained unprecedented control over their indoor environment. This allowed for tailored heating or cooling needs based solely on occupancy patterns—reducing wasted energy in unoccupied spaces while enhancing comfort where it mattered most.

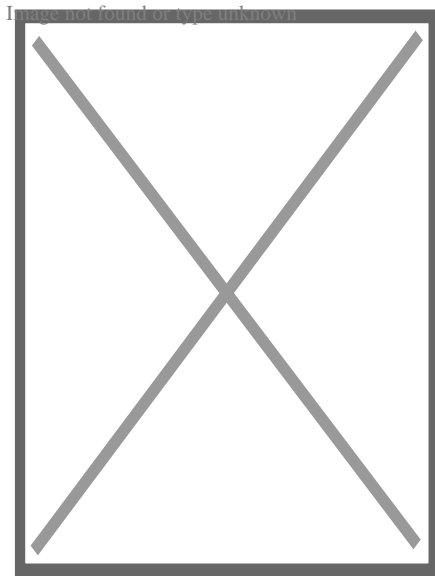
These case studies underscore the importance of revisiting traditional HVAC solutions within mobile homes. They highlight how strategic enhancements can yield substantial benefits—not just by improving thermal comfort but also by contributing positively towards sustainability.

goals through decreased energy usage.

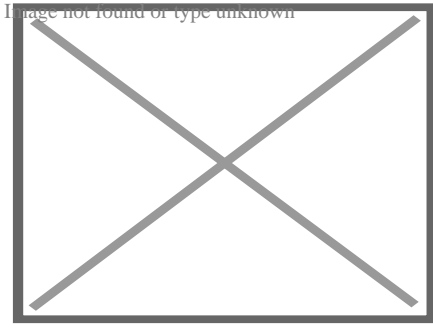
In conclusion, examining successful duct layout improvements provides a roadmap for other communities seeking similar advancements in air distribution systems within mobile homes. As technology progresses further alongside our understanding of efficient design principles, there is great potential for continued innovation that will elevate both quality-of-life metrics for residents and broader environmental objectives alike.

About Heat pump

This article is about devices used to heat and potentially also cool a building (or water) using the refrigeration cycle. For more about the theory, see Heat pump and refrigeration cycle. For details of the most common type, see air source heat pump. For a similar device for cooling only, see air conditioner. For heat pumps used to keep food cool, see refrigerator. For other uses, see Heat pump (disambiguation).



External heat exchanger of an air-source heat pump for both heating and cooling



Mitsubishi heat pump interior air handler wall unit

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Part of a series on

Sustainable energy

A car drives past 4 wind turbines in a field, with more on the horizon

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Energy conservation

- Arcology
- Building insulation
- Cogeneration
- Compact fluorescent lamp
- Eco hotel
- Eco-cities
- Ecohouse
- Ecolabel
- Efficient energy use
- Energy audit
- Energy efficiency implementation
- Energy recovery
- Energy recycling
- Energy saving lamp
- Energy Star
- Energy storage
- Environmental planning
- Environmental technology
- Fossil fuel phase-out
- Glass in green buildings
- Green building and wood
- Green building
- Heat pump
- List of low-energy building techniques
- Low-energy house
- Microgeneration
- Passive house
- Passive solar building design
- Sustainable architecture
- Sustainable city
- Sustainable habitat
- Sustainable refurbishment
- Thermal energy storage
- Tropical green building
- Waste-to-energy
- Zero heating building
- Zero-energy building

Renewable energy

- Biofuel
 - Sustainable
- Biogas
- Biomass
- Carbon-neutral fuel
- Geothermal energy
- Geothermal power
- Geothermal heating
- Hydropower
 - Hydroelectricity
 - Micro hydro
 - Pico hydro
 - Run-of-the-river
 - Small hydro
- Marine current power
- Marine energy
- Tidal power
 - Tidal barrage
 - Tidal farm
 - Tidal stream generator
- Ocean thermal energy conversion
- Renewable energy transition
- Renewable heat
- Solar
- Wave
- Wind
 - Community
 - Farm
 - Floating wind turbine
 - Forecasting
 - Industry
 - Lens
 - Outline
 - Rights
 - Turbine
 - Windbelt
 - Windpump

Sustainable transport

- Green vehicle
 - Electric vehicle
 - Bicycle
 - Solar vehicle
 - Wind-powered vehicle
- Hybrid vehicle
 - Human-electric
 - Twike
 - Plug-in
- Human-powered transport
 - Helicopter
 - Hydrofoil
 - Land vehicle
 - Bicycle
 - Cycle rickshaw
 - Kick scooter
 - Quadracycle
 - Tricycle
 - Velomobile
 - Roller skating
 - Skateboarding
 - Walking
 - Watercraft
- Personal transporter
- Rail transport
 - Tram
- Rapid transit
 - Personal rapid transit
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A **heat pump** is a device that consumes energy (usually electricity) to transfer heat from a cold heat sink to a hot heat sink. Specifically, the heat pump transfers thermal energy using a refrigeration cycle, cooling the cool space and warming the warm space.^[1] In cold weather, a heat pump can move heat from the cool outdoors to warm a house (e.g. winter); the pump may also be designed to move heat from the house to the warmer outdoors in warm weather (e.g. summer). As they transfer heat rather than generating heat, they are more energy-efficient than other ways of heating or cooling a home.^[2]

A gaseous refrigerant is compressed so its pressure and temperature rise. When operating as a heater in cold weather, the warmed gas flows to a heat exchanger in the indoor space where some of its thermal energy is transferred to that indoor space, causing the gas to

condense to its liquid state. The liquified refrigerant flows to a heat exchanger in the outdoor space where the pressure falls, the liquid evaporates and the temperature of the gas falls. It is now colder than the temperature of the outdoor space being used as a heat source. It can again take up energy from the heat source, be compressed and repeat the cycle.

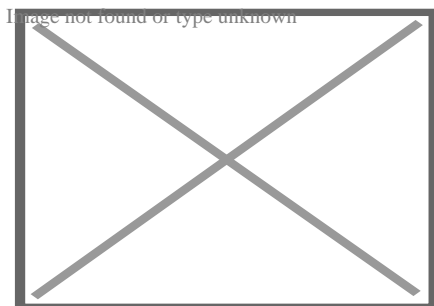
Air source heat pumps are the most common models, while other types include ground source heat pumps, water source heat pumps and exhaust air heat pumps.^[3] Large-scale heat pumps are also used in district heating systems.^[4]

The efficiency of a heat pump is expressed as a coefficient of performance (COP), or seasonal coefficient of performance (SCOP). The higher the number, the more efficient a heat pump is. For example, an air-to-water heat pump that produces 6kW at a SCOP of 4.62 will give over 4kW of energy into a heating system for every kilowatt of energy that the heat pump uses itself to operate. When used for space heating, heat pumps are typically more energy-efficient than electric resistance and other heaters.

Because of their high efficiency and the increasing share of fossil-free sources in electrical grids, heat pumps are playing a role in climate change mitigation.^[5]^[6] Consuming 1 kWh of electricity, they can transfer 1^[7] to 4.5 kWh of thermal energy into a building. The carbon footprint of heat pumps depends on how electricity is generated, but they usually reduce emissions.^[8] Heat pumps could satisfy over 80% of global space and water heating needs with a lower carbon footprint than gas-fired condensing boilers: however, in 2021 they only met 10%.^[4]

Principle of operation

[edit]



A: indoor compartment, B: outdoor compartment, I: insulation, 1: condenser, 2: expansion valve, 3: evaporator, 4: compressor

Main articles: Heat pump and refrigeration cycle and Vapor-compression refrigeration

Heat flows spontaneously from a region of higher temperature to a region of lower temperature. Heat does not flow spontaneously from lower temperature to higher, but it can be made to flow in this direction if work is performed. The work required to transfer a given amount of heat is usually much less than the amount of heat; this is the motivation for using

heat pumps in applications such as the heating of water and the interior of buildings.^[9]

The amount of work required to drive an amount of heat Q from a lower-temperature reservoir such as ambient air to a higher-temperature reservoir such as the interior of a

building is: Image not found or type unknown where

- W is the work performed on the working fluid by the heat pump's compressor.
- Q is the heat transferred from the lower-temperature reservoir to the higher-temperature reservoir.
- COP is the instantaneous coefficient of performance for the heat pump at the temperatures prevailing in the reservoirs at one instant.

The coefficient of performance of a heat pump is greater than one so the work required is less than the heat transferred, making a heat pump a more efficient form of heating than electrical resistance heating. As the temperature of the higher-temperature reservoir increases in response to the heat flowing into it, the coefficient of performance decreases, causing an increasing amount of work to be required for each unit of heat being transferred.^[9]

The coefficient of performance, and the work required by a heat pump can be calculated easily by considering an ideal heat pump operating on the reversed Carnot cycle:

- If the low-temperature reservoir is at a temperature of 270 K (−3 °C) and the interior of the building is at 280 K (7 °C) the relevant coefficient of performance is 27. This means only 1 joule of work is required to transfer 27 joules of heat from a reservoir at 270 K to another at 280 K. The one joule of work ultimately ends up as thermal energy in the interior of the building so for each 27 joules of heat that are removed from the low-temperature reservoir, 28 joules of heat are added to the building interior, making the heat pump even more attractive from an efficiency perspective.^[note 1]
- As the temperature of the interior of the building rises progressively to 300 K (27 °C) the coefficient of performance falls progressively to 9. This means each joule of work is responsible for transferring 9 joules of heat out of the low-temperature reservoir and into the building. Again, the 1 joule of work ultimately ends up as thermal energy in the interior of the building so 10 joules of heat are added to the building interior.^[note 2]

This is the theoretical amount of heat pumped but in practice it will be less for various reasons, for example if the outside unit has been installed where there is not enough airflow. More data sharing with owners and academics—perhaps from heat meters—could improve efficiency in the long run.^[11]

History

[edit]

Milestones:

1748

William Cullen demonstrates artificial refrigeration.[¹²]

1834

Jacob Perkins patents a design for a practical refrigerator using dimethyl ether.[¹³]

1852

Lord Kelvin describes the theory underlying heat pumps.[¹⁴]

1855–1857

Peter von Rittinger develops and builds the first heat pump.[¹⁵]

1877

In the period before 1875, heat pumps were for the time being pursued for vapour compression evaporation (open heat pump process) in salt works with their obvious advantages for saving wood and coal. In 1857, Peter von Rittinger was the first to try to implement the idea of vapor compression in a small pilot plant. Presumably inspired by Rittinger's experiments in Ebensee, Antoine-Paul Piccard from the University of Lausanne and the engineer J. H. Weibel from the Weibel–Briquet company in Geneva built the world's first really functioning vapor compression system with a two-stage piston compressor. In 1877 this first heat pump in Switzerland was installed in the Bex salt works.[¹⁴][¹⁶]

1928

Aurel Stodola constructs a closed-loop heat pump (water source from Lake Geneva) which provides heating for the Geneva city hall to this day.[¹⁷]

1937–1945

During the First World War, fuel prices were very high in Switzerland but it had plenty of hydropower.[¹⁴]

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In the period before and especially during the Second World War, when neutral Switzerland was completely surrounded by fascist-ruled countries, the coal shortage became alarming again. Thanks to their leading position in energy technology, the Swiss companies Sulzer, Escher Wyss and Brown Boveri built and put in operation around 35 heat pumps between 1937 and 1945. The main heat sources were lake water, river water, groundwater, and waste heat. Particularly noteworthy are the six historic heat pumps from the city of Zurich with heat outputs from 100 kW to 6 MW. An international milestone is the heat pump built by Escher Wyss in 1937/38 to replace the wood stoves in the City Hall of Zurich. To avoid noise and vibrations, a recently developed rotary piston compressor was used. This historic heat pump heated the town hall for 63 years until 2001. Only then was it replaced by a new, more efficient heat pump.[¹⁴]

1945

John Sumner, City Electrical Engineer for Norwich, installs an experimental water-source heat pump fed central heating system, using a nearby river to heat new Council administrative buildings. It had a seasonal efficiency ratio of 3.42, average thermal delivery of 147 kW, and peak output of 234 kW.[¹⁸]

1948

Robert C. Webber is credited as developing and building the first ground-source heat pump.[¹⁹]

1951

First large scale installation—the Royal Festival Hall in London is opened with a town gas-powered reversible water-source heat pump, fed by the Thames, for both winter heating and summer cooling needs.[¹⁸]

2019

The Kigali Amendment to phase out harmful refrigerants takes effect.

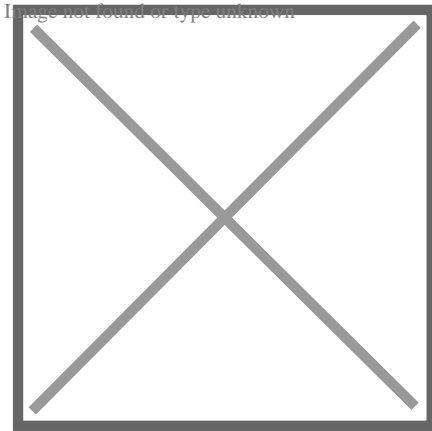
Types

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Air-source

[edit]

This section is an excerpt from Air source heat pump.[edit]



Heat pump on balcony of apartment

An air source heat pump (ASHP) is a heat pump that can absorb heat from air outside a building and release it inside; it uses the same vapor-compression refrigeration process and much the same equipment as an air conditioner, but in the opposite direction. ASHPs are the most common type of heat pump and, usually being smaller, tend to be used to heat individual houses or flats rather than blocks, districts or industrial processes.[²⁰][²¹]

Air-to-air heat pumps provide hot or cold air directly to rooms, but do not usually provide hot water. *Air-to-water* heat pumps use radiators or underfloor heating to heat a whole house and are often also used to provide domestic hot water.

An ASHP can typically gain 4 kWh thermal energy from 1 kWh electric energy. They are optimized for flow temperatures between 30 and 40 °C (86 and 104 °F), suitable for buildings with heat emitters sized for low flow temperatures. With losses in efficiency, an ASHP can even provide full central heating with a flow temperature up to 80 °C (176 °F).[²²]

As of 2023 about 10% of building heating worldwide is from ASHPs. They are the main way to phase out gas boilers (also known as "furnaces") from houses, to avoid their greenhouse gas emissions.[²³]

Air-source heat pumps are used to move heat between two heat exchangers, one outside the building which is fitted with fins through which air is forced using a fan and the other which either directly heats the air inside the building or heats water which is then circulated around the building through radiators or underfloor heating which releases the heat to the building. These devices can also operate in a cooling mode where they extract heat via the internal heat exchanger and eject it into the ambient air using the external heat exchanger. Some can be used to heat water for washing which is stored in a domestic hot water tank.[²⁴]

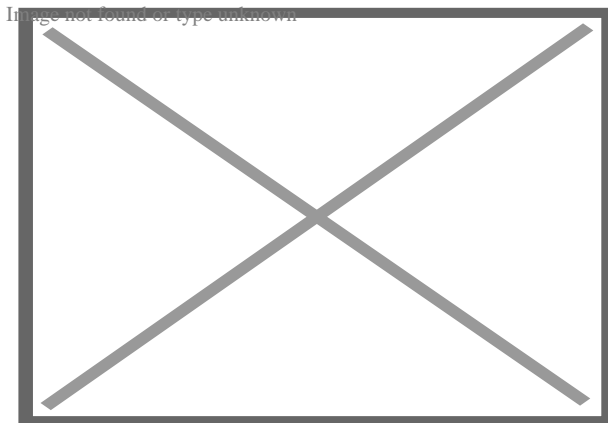
Air-source heat pumps are relatively easy and inexpensive to install, so are the most widely used type. In mild weather, coefficient of performance (COP) may be between 2 and 5, while at temperatures below around 7°C (45 °F) an air-source heat pump may still achieve a COP of 1 to 4.[²⁵]

While older air-source heat pumps performed relatively poorly at low temperatures and were better suited for warm climates, newer models with variable-speed compressors remain highly efficient in freezing conditions allowing for wide adoption and cost savings in places like Minnesota and Maine in the United States.[²⁶]

Ground source

[edit]

This section is an excerpt from Ground source heat pump.[edit]



A heat pump in combination with heat and cold storage

A ground source heat pump (also geothermal heat pump) is a heating/cooling system for buildings that use a type of heat pump to transfer heat to or from the ground, taking advantage of the relative constancy of temperatures of the earth through the seasons. Ground-source heat pumps (GSHPs) – or geothermal heat pumps (GHP), as they are commonly termed in North America – are among the most energy-efficient technologies for providing HVAC and water heating, using far less energy than can be achieved by burning a fuel in a boiler/furnace or by use of resistive electric heaters.

Efficiency is given as a coefficient of performance (CoP) which is typically in the range 3 –

6, meaning that the devices provide 3 – 6 units of heat for each unit of electricity used. Setup costs are higher than for other heating systems, due to the requirement to install ground loops over large areas or to drill bore holes, and for this reason, ground source is often suitable when new blocks of flats are built.^[27] Otherwise air-source heat pumps are often used instead.

Heat recovery ventilation

[edit]

Main article: Heat recovery ventilation

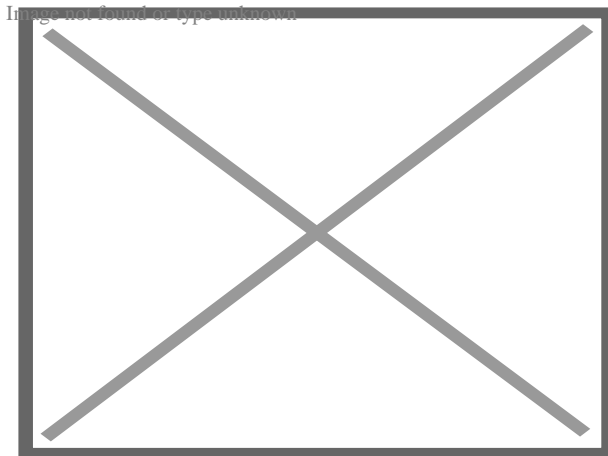
Exhaust air heat pumps extract heat from the exhaust air of a building and require mechanical ventilation. Two classes exist:

- Exhaust air-air heat pumps transfer heat to intake air.
- Exhaust air-water heat pumps transfer heat to a heating circuit that includes a tank of domestic hot water.

Solar-assisted

[edit]

This section is an excerpt from Solar-assisted heat pump.[edit]



Hybrid photovoltaic-thermal solar panels of a SAHP in an experimental installation at Department of Energy at Polytechnic of Milan

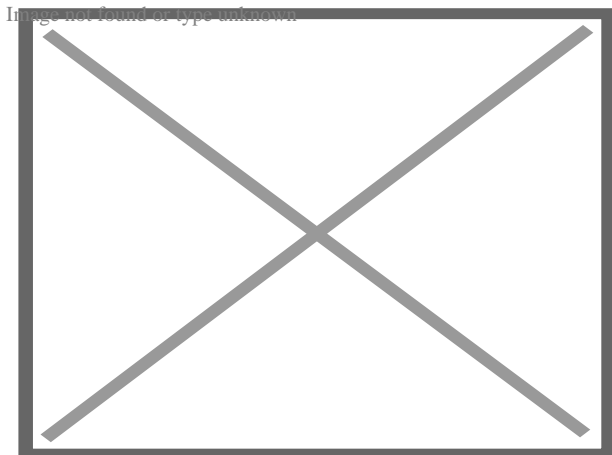
A solar-assisted heat pump (SAHP) is a machine that combines a heat pump and thermal solar panels and/or PV solar panels in a single integrated system.^[28] Typically these two technologies are used separately (or only placing them in parallel) to produce hot water.^[29] In this system the solar thermal panel performs the function of the low temperature heat source and the heat produced is used to feed the heat pump's evaporator.^[30] The goal of this system is to get high coefficient of performance (COP) and then produce energy in a more efficient and less expensive way.

It is possible to use any type of solar thermal panel (sheet and tubes, roll-bond, heat pipe,

thermal plates) or hybrid (mono/polycrystalline, thin film) in combination with the heat pump. The use of a hybrid panel is preferable because it allows covering a part of the electricity demand of the heat pump and reduce the power consumption and consequently the variable costs of the system.

Water-source

[edit]



Water-source heat exchanger being installed

A water-source heat pump works in a similar manner to a ground-source heat pump, except that it takes heat from a body of water rather than the ground. The body of water does, however, need to be large enough to be able to withstand the cooling effect of the unit without freezing or creating an adverse effect for wildlife.^[31] The largest water-source heat pump was installed in the Danish town of Esbjerg in 2023.^{[32][33]}

Others

[edit]

A thermoacoustic heat pump operates as a thermoacoustic heat engine without refrigerant but instead uses a standing wave in a sealed chamber driven by a loudspeaker to achieve a temperature difference across the chamber.^[34]

Electrocaloric heat pumps are solid state.^[35]

Applications

[edit]

The International Energy Agency estimated that, as of 2021, heat pumps installed in buildings have a combined capacity of more than 1000 GW.^[4] They are used for heating, ventilation, and air conditioning (HVAC) and may also provide domestic hot water and

tumble clothes drying.^[36] The purchase costs are supported in various countries by consumer rebates.^[37]

Space heating and sometimes also cooling

[edit]

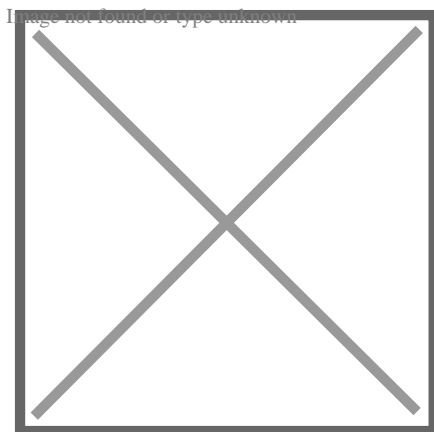
In HVAC applications, a heat pump is typically a vapor-compression refrigeration device that includes a reversing valve and optimized heat exchangers so that the direction of *heat flow* (thermal energy movement) may be reversed. The reversing valve switches the direction of refrigerant through the cycle and therefore the heat pump may deliver either heating or cooling to a building.

Because the two heat exchangers, the condenser and evaporator, must swap functions, they are optimized to perform adequately in both modes. Therefore, the Seasonal Energy Efficiency Rating (SEER in the US) or European seasonal energy efficiency ratio of a reversible heat pump is typically slightly less than those of two separately optimized machines. For equipment to receive the US Energy Star rating, it must have a rating of at least 14 SEER. Pumps with ratings of 18 SEER or above are considered highly efficient. The highest efficiency heat pumps manufactured are up to 24 SEER.^[38]

Heating seasonal performance factor (in the US) or Seasonal Performance Factor (in Europe) are ratings of heating performance. The SPF is Total heat output per annum / Total electricity consumed per annum in other words the average heating COP over the year.^[39]

Window mounted heat pump

[edit]



Saddle-style window mounted heat pump 3D sketch

Window mounted heat pumps run on standard 120v AC outlets and provide heating, cooling, and humidity control. They are more efficient with lower noise levels, condensation

management, and a smaller footprint than window mounted air conditioners that just do cooling.^[40]

Water heating

[edit]

In water heating applications, heat pumps may be used to heat or preheat water for swimming pools, homes or industry. Usually heat is extracted from outdoor air and transferred to an indoor water tank.^[41]^[42]

District heating

[edit]

Large (megawatt-scale) heat pumps are used for district heating.^[43] However as of 2022 about 90% of district heat is from fossil fuels.^[44] In Europe, heat pumps account for a mere 1% of heat supply in district heating networks but several countries have targets to decarbonise their networks between 2030 and 2040.^[4] Possible sources of heat for such applications are sewage water, ambient water (e.g. sea, lake and river water), industrial waste heat, geothermal energy, flue gas, waste heat from district cooling and heat from solar seasonal thermal energy storage.^[45] Large-scale heat pumps for district heating combined with thermal energy storage offer high flexibility for the integration of variable renewable energy. Therefore, they are regarded as a key technology for limiting climate change by phasing out fossil fuels.^[45]^[46] They are also a crucial element of systems which can both heat and cool districts.^[47]

Industrial heating

[edit]

There is great potential to reduce the energy consumption and related greenhouse gas emissions in industry by application of industrial heat pumps, for example for process heat.^[48]^[49] Short payback periods of less than 2 years are possible, while achieving a high reduction of CO₂ emissions (in some cases more than 50%).^[50]^[51] Industrial heat pumps can heat up to 200 °C, and can meet the heating demands of many light industries.^[52]^[53] In Europe alone, 15 GW of heat pumps could be installed in 3,000 facilities in the paper, food and chemicals industries.^[4]

Performance

[edit]

Main article: Coefficient of performance

The performance of a heat pump is determined by the ability of the pump to extract heat from a low temperature environment (the *source*) and deliver it to a higher temperature environment (the *sink*).^[54] Performance varies, depending on installation details, temperature differences, site elevation, location on site, pipe runs, flow rates, and maintenance.

In general, heat pumps work most efficiently (that is, the heat output produced for a given energy input) when the difference between the heat source and the heat sink is small. When using a heat pump for space or water heating, therefore, the heat pump will be most efficient in mild conditions, and decline in efficiency on very cold days. Performance metrics supplied to consumers attempt to take this variation into account.

Common performance metrics are the SEER (in cooling mode) and seasonal coefficient of performance (SCOP) (commonly used just for heating), although SCOP can be used for both modes of operation.^[54] Larger values of either metric indicate better performance.^[54] When comparing the performance of heat pumps, the term *performance* is preferred to *efficiency*, with coefficient of performance (COP) being used to describe the ratio of useful heat movement per work input.^[54] An electrical resistance heater has a COP of 1.0, which is considerably lower than a well-designed heat pump which will typically have a COP of 3 to 5 with an external temperature of 10 °C and an internal temperature of 20 °C. Because the ground is a constant temperature source, a ground-source heat pump is not subjected to large temperature fluctuations, and therefore is the most energy-efficient type of heat pump.^[54]

The "seasonal coefficient of performance" (SCOP) is a measure of the aggregate energy efficiency measure over a period of one year which is dependent on regional climate.^[54] One framework for this calculation is given by the Commission Regulation (EU) No. 813/2013.^[55]

A heat pump's operating performance in cooling mode is characterized in the US by either its energy efficiency ratio (EER) or seasonal energy efficiency ratio (SEER), both of which have units of BTU/(h·W) (note that 1 BTU/(h·W) = 0.293 W/W) and larger values indicate better performance.

| COP variation with output temperature | | |
|---------------------------------------|-------------|----------------------------------|
| Pump type and source | Typical use | 35 °C (e.g. heated screed floor) |

| | | | |
|--|-------------------------|-----|--|
| High-efficiency air-source heat pump (ASHP), air at 20 °C [56] | | 2.2 | |
| Two-stage ASHP, air at 20 °C [57] | Low source temperature | 2.4 | |
| High-efficiency ASHP, air at 0 °C [56] | Low output temperature | 3.8 | |
| Prototype transcritical CO ₂ (R744) heat pump with tripartite gas cooler, source at 0 °C [58] | High output temperature | 3.3 | |
| Ground-source heat pump (GSHP), water at 0 °C [56] | | 5.0 | |
| GSHP, ground at 10 °C [56] | Low output temperature | 7.2 | |
| Theoretical Carnot cycle limit, source 20 °C | | 5.6 | |
| Theoretical Carnot cycle limit, source 0 °C | | 8.8 | |

| | |
|---|------|
| Theoretical Lorentzen cycle limit (CO ₂ pump), return fluid 25 °C, source 0 °C ^[58] | 10.1 |
| Theoretical Carnot cycle limit, source 10 °C | 12.3 |

Carbon footprint

[edit]

The carbon footprint of heat pumps depends on their individual efficiency and how electricity is produced. An increasing share of low-carbon energy sources such as wind and solar will lower the impact on the climate.

| heating system | emissions of energy source | efficiency | resulting emissions for thermal energy |
|--|--|----------------------------------|--|
| heat pump with onshore wind power | 11 gCO ₂ /kWh ^[59] | 400% (COP=4) | 3 gCO ₂ /kWh |
| heat pump with global electricity mix | 436 gCO ₂ /kWh ^[60] (2022) | 400% (COP=4) | 109 gCO ₂ /kWh |
| natural-gas thermal (high efficiency) | 201 gCO ₂ /kWh ^[61] | 90% ^[citation needed] | 223 gCO ₂ /kWh |
| heat pump electricity by lignite (old power plant) and low performance | 1221 gCO ₂ /kWh ^[61] | 300% (COP=3) | 407 gCO ₂ /kWh |

In most settings, heat pumps will reduce CO₂ emissions compared to heating systems powered by fossil fuels.^[62] In regions accounting for 70% of world energy consumption, the emissions savings of heat pumps compared with a high-efficiency gas boiler are on average above 45% and reach 80% in countries with cleaner electricity mixes.^[4] These values can be improved by 10 percentage points, respectively, with alternative refrigerants. In the United States, 70% of houses could reduce emissions by installing a heat pump.^[63]^[4] The rising share of renewable electricity generation in many countries is set to increase the emissions savings from heat pumps over time.^[4]

Heating systems powered by green hydrogen are also low-carbon and may become competitors, but are much less efficient due to the energy loss associated with hydrogen conversion, transport and use. In addition, not enough green hydrogen is expected to be available before the 2030s or 2040s.^{[64][65]}

Operation

[edit]

See also: Vapor-compression refrigeration



This section **needs additional citations for verification**. Please help improve this article by adding citations to reliable sources in this section. Unsourced material may be challenged and removed. *(May 2021)* *(Learn how and when to remove this message)*

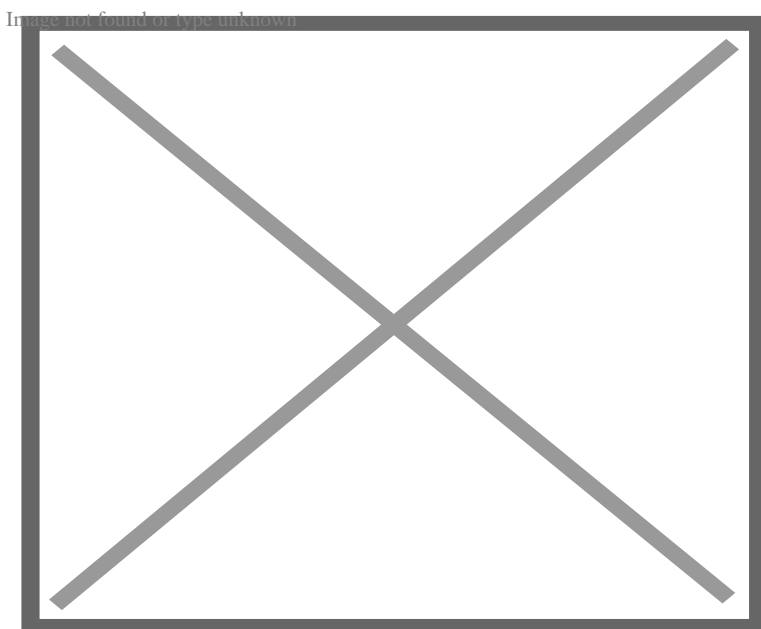
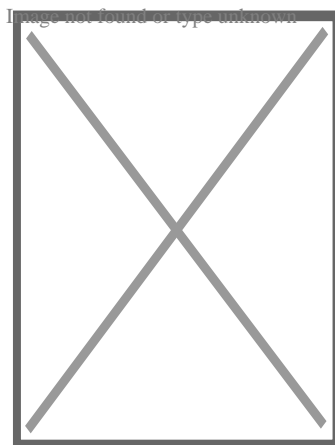
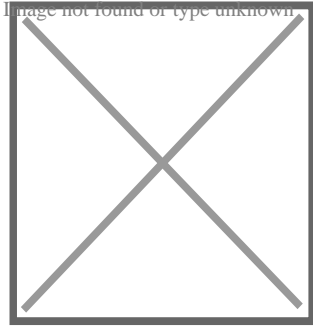


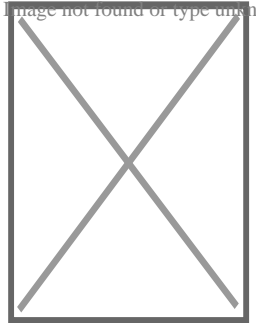
Figure 2: Temperature–entropy diagram of the vapor-compression cycle



An internal view of the outdoor unit of an Ecodan air source heat pump



Large heat pump setup for a commercial building



Wiring and connections to a central air unit inside

Vapor-compression uses a circulating refrigerant as the medium which absorbs heat from one space, compresses it thereby increasing its temperature before releasing it in another space. The system normally has eight main components: a compressor, a reservoir, a reversing valve which selects between heating and cooling mode, two thermal expansion valves (one used when in heating mode and the other when used in cooling mode) and two heat exchangers, one associated with the external heat source/sink and the other with the interior. In heating mode the external heat exchanger is the evaporator and the internal one being the condenser; in cooling mode the roles are reversed.

Circulating refrigerant enters the compressor in the thermodynamic state known as a saturated vapor^[66] and is compressed to a higher pressure, resulting in a higher temperature as well. The hot, compressed vapor is then in the thermodynamic state known as a superheated vapor and it is at a temperature and pressure at which it can be condensed with either cooling water or cooling air flowing across the coil or tubes. In heating mode this heat is used to heat the building using the internal heat exchanger, and in cooling mode this heat is rejected via the external heat exchanger.

The condensed, liquid refrigerant, in the thermodynamic state known as a saturated liquid, is next routed through an expansion valve where it undergoes an abrupt reduction in pressure. That pressure reduction results in the adiabatic flash evaporation of a part of the liquid refrigerant. The auto-refrigeration effect of the adiabatic flash evaporation lowers the

temperature of the liquid and-vapor refrigerant mixture to where it is colder than the temperature of the enclosed space to be refrigerated.

The cold mixture is then routed through the coil or tubes in the evaporator. A fan circulates the warm air in the enclosed space across the coil or tubes carrying the cold refrigerant liquid and vapor mixture. That warm air evaporates the liquid part of the cold refrigerant mixture. At the same time, the circulating air is cooled and thus lowers the temperature of the enclosed space to the desired temperature. The evaporator is where the circulating refrigerant absorbs and removes heat which is subsequently rejected in the condenser and transferred elsewhere by the water or air used in the condenser.

To complete the refrigeration cycle, the refrigerant vapor from the evaporator is again a saturated vapor and is routed back into the compressor.

Over time, the evaporator may collect ice or water from ambient humidity. The ice is melted through defrosting cycle. An internal heat exchanger is either used to heat/cool the interior air directly or to heat water that is then circulated through radiators or underfloor heating circuit to either heat or cool the buildings.

Improvement of coefficient of performance by subcooling

[edit]

Main article: Subcooling

Heat input can be improved if the refrigerant enters the evaporator with a lower vapor content. This can be achieved by cooling the liquid refrigerant after condensation. The gaseous refrigerant condenses on the heat exchange surface of the condenser. To achieve a heat flow from the gaseous flow center to the wall of the condenser, the temperature of the liquid refrigerant must be lower than the condensation temperature.

Additional subcooling can be achieved by heat exchange between relatively warm liquid refrigerant leaving the condenser and the cooler refrigerant vapor emerging from the evaporator. The enthalpy difference required for the subcooling leads to the superheating of the vapor drawn into the compressor. When the increase in cooling achieved by subcooling is greater than the compressor drive input required to overcome the additional pressure losses, such a heat exchange improves the coefficient of performance.^[67]

One disadvantage of the subcooling of liquids is that the difference between the condensing temperature and the heat-sink temperature must be larger. This leads to a moderately high pressure difference between condensing and evaporating pressure, whereby the compressor energy increases.

Refrigerant choice

[edit]

Main article: Refrigerant

Pure refrigerants can be divided into organic substances (hydrocarbons (HCs), chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs), hydrofluoroolefins (HFOs), and HCFOs), and inorganic substances (ammonia (NH₃), carbon dioxide (CO₂), and water (H₂O))^[68].^[69] Their boiling points are usually below 25 °C.^[70]

In the past 200 years, the standards and requirements for new refrigerants have changed. Nowadays low global warming potential (GWP) is required, in addition to all the previous requirements for safety, practicality, material compatibility, appropriate atmospheric life,^[clarification] and compatibility with high-efficiency products. By 2022, devices using refrigerants with a very low GWP still have a small market share but are expected to play an increasing role due to enforced regulations,^[71] as most countries have now ratified the Kigali Amendment to ban HFCs.^[72] Isobutane (R600A) and propane (R290) are far less harmful to the environment than conventional hydrofluorocarbons (HFC) and are already being used in air-source heat pumps.^[73] Propane may be the most suitable for high temperature heat pumps.^[74] Ammonia (R717) and carbon dioxide (R-744) also have a low GWP. As of 2023 smaller CO₂ heat pumps are not widely available and research and development of them continues.^[75] A 2024 report said that refrigerants with GWP are vulnerable to further international restrictions.^[76]

Until the 1990s, heat pumps, along with fridges and other related products used chlorofluorocarbons (CFCs) as refrigerants, which caused major damage to the ozone layer when released into the atmosphere. Use of these chemicals was banned or severely restricted by the Montreal Protocol of August 1987.^[77]

Replacements, including R-134a and R-410A, are hydrofluorocarbons (HFC) with similar thermodynamic properties with insignificant ozone depletion potential (ODP) but had problematic GWP.^[78] HFCs are powerful greenhouse gases which contribute to climate change.^[79]^[80] Dimethyl ether (DME) also gained in popularity as a refrigerant in combination with R404a.^[81] More recent refrigerants include difluoromethane (R32) with a lower GWP, but still over 600.

| refrigerant | 20-year GWP | 100-year GWP |
|-------------------------------|-------------|-------------------|
| R-290 propane ^[82] | 0.072 | 0.02 |
| R-600a isobutane | | 3 ^[83] |
| R-32 ^[82] | 491 | 136 |
| R-410a ^[84] | 4705 | 2285 |
| R-134a ^[84] | 4060 | 1470 |
| R-404a ^[84] | 7258 | 4808 |

Devices with R-290 refrigerant (propane) are expected to play a key role in the future.^{[74][85]} The 100-year GWP of propane, at 0.02, is extremely low and is approximately 7000 times less than R-32. However, the flammability of propane requires additional safety measures: the maximum safe charges have been set significantly lower than for lower flammability refrigerants (only allowing approximately 13.5 times less refrigerant in the system than R-32).^{[86][87][88]} This means that R-290 is not suitable for all situations or locations. Nonetheless, by 2022, an increasing number of devices with R-290 were offered for domestic use, especially in Europe.^[citation needed]

At the same time,^[when?] HFC refrigerants still dominate the market. Recent government mandates have seen the phase-out of R-22 refrigerant. Replacements such as R-32 and R-410A are being promoted as environmentally friendly but still have a high GWP.^[89] A heat pump typically uses 3 kg of refrigerant. With R-32 this amount still has a 20-year impact equivalent to 7 tons of CO₂, which corresponds to two years of natural gas heating in an average household. Refrigerants with a high ODP have already been phased out.^[citation needed]

Government incentives

[edit]

Financial incentives aim to protect consumers from high fossil gas costs and to reduce greenhouse gas emissions,^[90] and are currently available in more than 30 countries around the world, covering more than 70% of global heating demand in 2021.^[4]

Australia

[edit]

Food processors, brewers, petfood producers and other industrial energy users are exploring whether it is feasible to use renewable energy to produce industrial-grade heat. Process heating accounts for the largest share of onsite energy use in Australian manufacturing, with lower-temperature operations like food production particularly well-suited to transition to renewables.

To help producers understand how they could benefit from making the switch, the Australian Renewable Energy Agency (ARENA) provided funding to the Australian Alliance for Energy Productivity (A2EP) to undertake pre-feasibility studies at a range of sites around Australia, with the most promising locations advancing to full feasibility studies.^[91]

In an effort to incentivize energy efficiency and reduce environmental impact, the Australian states of Victoria, New South Wales, and Queensland have implemented rebate programs targeting the upgrade of existing hot water systems. These programs specifically encourage the transition from traditional gas or electric systems to heat pump based systems.^{[92][93][94][95][96]}

Canada

[edit]

In 2022, the Canada Greener Homes Grant^[97] provides up to \$5000 for upgrades (including certain heat pumps), and \$600 for energy efficiency evaluations.

China

[edit]

Purchase subsidies in rural areas in the 2010s reduced burning coal for heating, which had been causing ill health.^[98]

In the 2024 report by the International Energy Agency (IEA) titled "The Future of Heat Pumps in China," it is highlighted that China, as the world's largest market for heat pumps in buildings, plays a critical role in the global industry. The country accounts for over one-quarter of global sales, with a 12% increase in 2023 alone, despite a global sales dip of 3% the same year.^[99]

Heat pumps are now used in approximately 8% of all heating equipment sales for buildings in China as of 2022, and they are increasingly becoming the norm in central and southern regions for both heating and cooling. Despite their higher upfront costs and relatively low awareness, heat pumps are favored for their energy efficiency, consuming three to five times less energy than electric heaters or fossil fuel-based solutions. Currently, decentralized heat pumps installed in Chinese buildings represent a quarter of the global installed capacity, with a total capacity exceeding 250 GW, which covers around 4% of the heating needs in buildings.^[99]

Under the Announced Pledges Scenario (APS), which aligns with China's carbon neutrality goals, the capacity is expected to reach 1,400 GW by 2050, meeting 25% of heating needs. This scenario would require an installation of about 100 GW of heat pumps annually until 2050. Furthermore, the heat pump sector in China employs over 300,000 people, with employment numbers expected to double by 2050, underscoring the importance of vocational training for industry growth. This robust development in the heat pump market is set to play a significant role in reducing direct emissions in buildings by 30% and cutting PM2.5 emissions from residential heating by nearly 80% by 2030.^{[99][100]}

European Union

[edit]

To speed up the deployment rate of heat pumps, the European Commission launched the Heat Pump Accelerator Platform in November 2024.^[101] It will encourage industry experts,

policymakers, and stakeholders to collaborate, share best practices and ideas, and jointly discuss measures that promote sustainable heating solutions.^[102]

United Kingdom

[edit]

As of 2022: heat pumps have no Value Added Tax (VAT) although in Northern Ireland they are taxed at the reduced rate of 5% instead of the usual level of VAT of 20% for most other products.^[103] As of 2022 the installation cost of a heat pump is more than a gas boiler, but with the "Boiler Upgrade Scheme"^[104] government grant and assuming electricity/gas costs remain similar their lifetime costs would be similar on average.^[105] However lifetime cost relative to a gas boiler varies considerably depending on several factors, such as the quality of the heat pump installation and the tariff used.^[106] In 2024 England was criticised for still allowing new homes to be built with gas boilers, unlike some other counties where this is banned.^[107]

United States

[edit]

Further information: Environmental policy of the Joe Biden administration and Climate change in the United States

The High-efficiency Electric Home Rebate Program was created in 2022 to award grants to State energy offices and Indian Tribes in order to establish state-wide high-efficiency electric-home rebates. Effective immediately, American households are eligible for a tax credit to cover the costs of buying and installing a heat pump, up to \$2,000. Starting in 2023, low- and moderate-level income households will be eligible for a heat-pump rebate of up to \$8,000.^[108]

In 2022, more heat pumps were sold in the United States than natural gas furnaces.^[109]

In November 2023 Biden's administration allocated 169 million dollars from the Inflation Reduction Act to speed up production of heat pumps. It used the Defense Production Act to do so, because according to the administration, energy that is better for the climate is also better for national security.^[110]

Notes

[edit]

- [^] As explained in Coefficient of performance TheoreticalMaxCOP = $(\text{desiredIndoorTempC} + 273) \div (\text{desiredIndoorTempC} - \text{outsideTempC}) = (7+273) \div (7 - (-3)) = 280 \div 10 = 28$ ^[10]
- [^] As explained in Coefficient of performance TheoreticalMaxCOP = $(\text{desiredIndoorTempC} + 273) \div (\text{desiredIndoorTempC} - \text{outsideTempC}) = (27+273) \div$

$$(27 - (-3)) = 300 \div 30 = 10[^{10}]$$

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Heating, ventilation, and air conditioning

**Fundamental
concepts**

- Air changes per hour
- Bake-out
- Building envelope
- Convection
- Dilution
- Domestic energy consumption
- Enthalpy
- Fluid dynamics
- Gas compressor
- Heat pump and refrigeration cycle
- Heat transfer
- Humidity
- Infiltration
- Latent heat
- Noise control
- Outgassing
- Particulates
- Psychrometrics
- Sensible heat
- Stack effect
- Thermal comfort
- Thermal destratification
- Thermal mass
- Thermodynamics
- Vapour pressure of water

Technology

- Absorption-compression heat pump
- Absorption refrigerator
- Air barrier
- Air conditioning
- Antifreeze
- Automobile air conditioning
- Autonomous building
- Building insulation materials
- Central heating
- Central solar heating
- Chilled beam
- Chilled water
- Constant air volume (CAV)
- Coolant
- Cross ventilation
- Dedicated outdoor air system (DOAS)
- Deep water source cooling
- Demand controlled ventilation (DCV)
- Displacement ventilation
- District cooling
- District heating
- Electric heating
- Energy recovery ventilation (ERV)
- Firestop
- Forced-air
- Forced-air gas
- Free cooling
- Heat recovery ventilation (HRV)
- Hybrid heat
- Hydronics
- Ice storage air conditioning
- Kitchen ventilation
- Mixed-mode ventilation
- Microgeneration
- Passive cooling
- Passive daytime radiative cooling
- Passive house
- Passive ventilation
- Radiant heating and cooling
- Radiant cooling
- Radiant heating
- Radon mitigation
- Refrigeration
- Renewable heat
- Room air distribution
- Solar air heat
- Solar combisystem
- Solar cooling
- Solar heating
- Thermal insulation

- Air conditioner inverter
- Air door
- Air filter
- Air handler
- Air ionizer
- Air-mixing plenum
- Air purifier
- Air source heat pump
- Attic fan
- Automatic balancing valve
- Back boiler
- Barrier pipe
- Blast damper
- Boiler
- Centrifugal fan
- Ceramic heater
- Chiller
- Condensate pump
- Condenser
- Condensing boiler
- Convection heater
- Compressor
- Cooling tower
- Damper
- Dehumidifier
- Duct
- Economizer
- Electrostatic precipitator
- Evaporative cooler
- Evaporator
- Exhaust hood
- Expansion tank
- Fan
- Fan coil unit
- Fan filter unit
- Fan heater
- Fire damper
- Fireplace
- Fireplace insert
- Freeze stat
- Flue
- Freon
- Fume hood
- Furnace
- Gas compressor
- Gas heater
- Gasoline heater
- Grease duct
- Grille
- Ground-coupled heat exchanger

Components

**Measurement
and control**

- Air flow meter
- Aquastat
- BACnet
- Blower door
- Building automation
- Carbon dioxide sensor
- Clean air delivery rate (CADR)
- Control valve
- Gas detector
- Home energy monitor
- Humidistat
- HVAC control system
- Infrared thermometer
- Intelligent buildings
- LonWorks
- Minimum efficiency reporting value (MERV)
- Normal temperature and pressure (NTP)
- OpenTherm
- Programmable communicating thermostat
- Programmable thermostat
- Psychrometrics
- Room temperature
- Smart thermostat
- Standard temperature and pressure (STP)
- Thermographic camera
- Thermostat
- Thermostatic radiator valve
- Architectural acoustics
- Architectural engineering
- Architectural technologist
- Building services engineering
- Building information modeling (BIM)
- Deep energy retrofit

**Professions,
trades,
and services**

- Duct cleaning
- Duct leakage testing
- Environmental engineering
- Hydronic balancing
- Kitchen exhaust cleaning
- Mechanical engineering
- Mechanical, electrical, and plumbing
- Mold growth, assessment, and remediation
- Refrigerant reclamation
- Testing, adjusting, balancing

Industry organizations

- AHRI
- AMCA
- ASHRAE
- ASTM International
- BRE
- BSRIA
- CIBSE
- Institute of Refrigeration
- IIR
- LEED
- SMACNA
- UMC
- Indoor air quality (IAQ)
- Passive smoking
- Sick building syndrome (SBS)
- Volatile organic compound (VOC)
- ASHRAE Handbook
- Building science
- Fireproofing
- Glossary of HVAC terms
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Health and safety

See also

- Germany
- United States
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Things To Do in Tulsa County

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Blue Whale of Catoosa

4.5 (3899)

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Woodward Park and Gardens

4.7 (2580)

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Oxley Nature Center

4.8 (563)

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Golden Driller Statue

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Reviews for Durham Supply Inc

Durham Supply Inc

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Dennis Champion

(5)

Durham supply and Royal supply seems to find the most helpful and friendly people to work in their stores, we are based out of Kansas City out here for a few remodels and these guys treated us like we've gone there for years.

Durham Supply Inc

Image not found or type unknown

Ty Spears

(5)

Bought a door/storm door combo. Turns out it was the wrong size. They swapped it out, quick and easy no problems. Very helpful in explaining the size differences from standard door sizes.

Durham Supply Inc

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Gerald Clifford Brewster

(5)

We will see, the storm door I bought says on the tag it's 36x80, but it's 34x80. If they return it.....they had no problems returning it. And it was no fault of there's, you measure a mobile home door different than a standard door!

Durham Supply Inc

Image not found or type unknown

B Mann

(5)

I was in need of some items for a double wide that I am remodeling and this place is the only place in town that had what I needed (I didn't even try the other rude place)while I was there I learned the other place that was in Tulsa that also sold mobile home supplies went out of business (no wonder the last time I was in there they were VERY RUDE and high priced) I like the way Dunham does business they answered all my questions and got me the supplies I needed, very friendly, I will be back to purchase the rest of my items when the time comes.

Durham Supply Inc

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Ethel Schiller

(5)

This place is really neat, if they don't have it they can order it from another of their stores and have it there overnight in most cases. Even hard to find items for a trailer! I definitely recommend this place to everyone! O and the prices is awesome too!

Examining Duct Layout for Better Distribution [View GBP](#)

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- [Noting Electrical Hazard Precautions in Mobile Home HVAC Projects](#)
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- **Conducting On Site Safety Assessments Before Mobile Home AC Repairs**
- **Checking Gas Line Integrity in Mobile Home Heating Systems**

Frequently Asked Questions

What are the key factors to consider when examining duct layout for better air distribution in a mobile home HVAC system?

Key factors include the size and length of ducts, the placement of supply and return vents, insulation quality, and ensuring there are no leaks or obstructions. Properly sized ducts ensure efficient airflow, while optimal vent placement helps maintain consistent temperature throughout the mobile home.

How can improper duct layout affect the efficiency of a mobile homes HVAC system?

Improper duct layout can lead to uneven heating or cooling, increased energy consumption, and higher utility bills. It may cause some areas to become too hot or cold while others remain unaffected. Additionally, it can strain the HVAC system as it works harder to achieve desired temperatures.

What steps can be taken to improve duct layout in a mobile home for better air distribution?

To improve duct layout, conduct an assessment of current ductwork for any issues like leaks or blockages. Consider resizing ducts if they are too small or large for the space. Realign or add additional vents as needed for balanced airflow. Insulating ducts can also prevent heat loss and improve efficiency.

Why is it important to seal and insulate ducts in a mobile home HVAC system?

Sealing and insulating ducts prevent air leaks that reduce system efficiency by allowing conditioned air to escape before reaching living spaces. This leads to inconsistent temperatures and increased energy use. Proper sealing ensures maximum airflow reaches intended areas while insulation maintains desired temperature levels within the ducts.

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