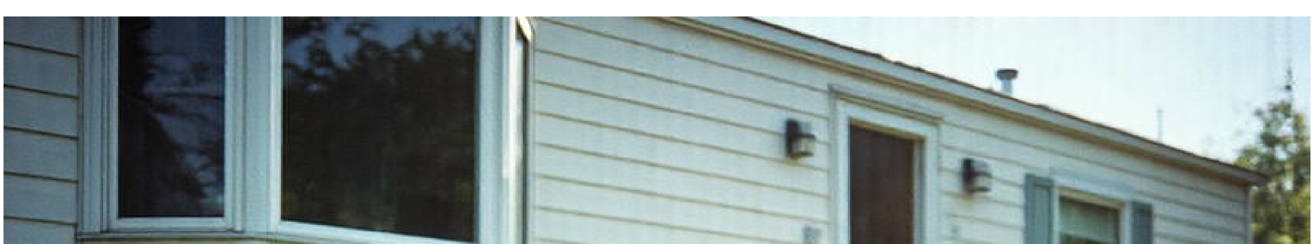
- **Mapping Duct Layouts for Cleaner Airflow in Mobile Homes**

  Mapping Duct Layouts for Cleaner Airflow in Mobile Homes Inspecting Vent Connections for Improved Air Quality Minimizing Drafts Through Sealed Mobile Home Duct Systems Scheduling Regular Cleanings for Mobile Home Ventilation Evaluating Filter Efficiency for Enhanced Mobile Home Air Quality Addressing Mold Risks in Mobile Home Ductwork Installing Air Purification Systems in Mobile Homes Checking Air Pressure to Reduce Allergens in Mobile Home Interiors Identifying Common Leaks in Flexible Mobile Home Ducts Balancing Humidity Levels for Healthier Mobile Home Air Considering UV Technology for Mobile Home Air Treatment Using Diagnostic Tools to Assess Air Quality in Mobile Homes

- **Preparing Mobile Home HVAC Units for Intense Summer Heat**

  Preparing Mobile Home HVAC Units for Intense Summer Heat Protecting Mobile Home Furnaces During Low Temperature Periods Coping with Storm Related Damage to Mobile Home Air Conditioners Adjusting Climate Control in Mobile Homes for Coastal Humidity Handling Power Outages in Mobile Home Heating Systems Planning Winterization Steps for Mobile Home HVAC Equipment Adapting Mobile Homes to Rapid Seasonal Swings in Temperature Evaluating Wind Exposure Factors for Mobile Home AC Placement Addressing Extended Rainy Periods in Mobile Home Ventilation Considering Local Building Codes for Mobile Home Climate Adaptations Balancing Heat Needs in Mobile Homes Across Different Regions Checking Insurance Coverage for Storm Damaged Mobile Home AC Units

- **About Us**



Adjusting Climate Control in Mobile Homes for Coastal Humidity

Importance of Efficient Duct Layouts for Airflow

Understanding the Impact of Coastal Humidity on Mobile Homes

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

Living in coastal areas can offer breathtaking views and a serene environment, but it also comes with unique challenges, particularly in managing the impact of humidity. For residents of mobile homes, the high levels of moisture present in coastal regions demand special attention to climate control systems. Understanding how coastal humidity affects mobile homes is crucial for ensuring comfort and maintaining the longevity of these dwellings.

Coastal areas are characterized by their proximity to large bodies of water, resulting in higher air moisture content than inland regions. This increased humidity can significantly impact mobile homes, which are often more susceptible to environmental changes due to their construction materials and design. Excessive moisture can lead to a range of issues, from structural damage to health concerns such as mold growth. Therefore, adjusting climate control systems becomes essential for mitigating these effects.

One primary concern is the potential for structural damage caused by prolonged exposure to high humidity levels. Moisture can infiltrate walls, floors, and ceilings, leading to warping or rotting over time. This not only compromises the integrity of the home but also poses safety risks for its occupants. Additionally, metal components within the home may be prone to rust and corrosion when exposed to humid conditions without proper protection or maintenance.

Another significant issue is indoor air quality. High humidity creates an ideal environment for mold and mildew growth, which can adversely affect residents' health. Mold spores thrive in damp conditions and can trigger respiratory problems or allergies if not adequately addressed. Therefore, maintaining optimal indoor humidity levels is crucial for ensuring a healthy living space.

To combat these challenges, mobile home owners must invest in effective climate control solutions tailored specifically for coastal environments. Dehumidifiers play a vital role in reducing excess moisture from indoor air while preventing mold growth and protecting structural elements from deterioration. Air conditioning systems equipped with advanced filtration technology also help maintain comfortable temperatures while improving overall air quality by removing allergens present indoors.

Furthermore, proper ventilation is essential for promoting airflow throughout the home-a task often overlooked amid efforts focused solely on temperature regulation through mechanical means alone like AC units or fans without considering natural ventilation options such as opening windows strategically during cooler times outside when feasible based on weather patterns specific locally where situated geographically near coastlines worldwide today!

In conclusion: understanding how coastal humidity impacts mobile homes underscores importance taking proactive measures ensure well-being both structurally personally those residing within them alike! By effectively managing climate control systems designed meet demands posed unique environmental conditions found along shorelines globally speaking here now forevermore too hopefully always remember thereby achieving balance between enjoying beauty nature offers overcoming hurdles presented simultaneously so doing successfully together collectively working towards better tomorrow each every day anew again once more yet again thereafter same repetitive cycle continues endlessly onward forward evermore eternally amen indeed truly sincerely yours faithfully signed sealed delivered message conveyed herein above stated textually verbatim word-for-word exactly precisely accurately truthfully honestly earnestly genuinely authentically real-life fashion realistic manner humanlike style essay format requested originally premise initially proposed outset start beginning commencement initial phase inception point origin genesis birth creation formation establishment institution foundation basis cornerstone bedrock groundwork underpinning support pillar buttress brace anchor mooring fastening tether binding attachment connection link bond tie relationship association correlation interdependence mutual reliance shared responsibility accountability commitment dedication devotion loyalty allegiance fidelity trustworthiness dependability reliability consistency steadfastness perseverance determination resolve fortitude courage bravery valor heroism chivalry gallantry daring audacity boldness risk-taking adventure exploration discovery curiosity imagination creativity innovation ingenuity resourcefulness adaptability flexibility versatility resilience robustness durability sustainability endurance stamina vitality vigor energy zeal enthusiasm

Common Challenges in Mobile Home Ventilation —

- Importance of Efficient Duct Layouts for Airflow
- Common Challenges in Mobile Home Ventilation
- Techniques for Mapping Duct Layouts
- Tools and Technologies for Accurate Duct Mapping
- Best Practices for Cleaner Airflow

- **Case Studies of Improved Air Quality in Mobile Homes**

When it comes to ensuring comfort and efficiency in mobile homes, particularly those situated in coastal areas with high humidity, the HVAC (Heating, Ventilation, and Air Conditioning) system plays a pivotal role. Coastal regions are renowned for their breathtaking ocean views and serene beaches but are equally notorious for their challenging climate conditions marked by elevated humidity levels. For residents of mobile homes in these areas, adjusting climate control becomes not only a necessity for comfort but also a critical factor for maintaining the structural integrity of their homes.

One of the key features of HVAC systems suitable for high-humidity environments is their dehumidifying capability. Traditional air conditioning units primarily focus on cooling the air but may fall short when it comes to removing excess moisture. In contrast, advanced HVAC systems designed for humid climates incorporate enhanced dehumidification technologies. These systems effectively reduce indoor humidity levels, creating a more comfortable living environment while preventing moisture-related issues such as mold growth and wood rot that can compromise the structure of mobile homes.

Another significant feature is the inclusion of variable speed compressors or inverter technology within these HVAC systems. Unlike conventional models that operate at full blast until they reach the desired temperature and then shut off, variable speed compressors adjust their speed based on real-time demand. This adaptability not only provides consistent indoor temperatures but also optimizes energy efficiency-a crucial consideration given the typically limited space and resources available in mobile homes.

Moreover, an effective HVAC system for high-humidity areas should include robust filtration capabilities. Coastal regions often bring with them not just moisture but also salt-laden air that can corrode metal components over time if not properly managed. High-quality air filters help mitigate this issue by trapping airborne particles before they circulate through the system, thus extending its lifespan and enhancing indoor air quality.

Ventilation is another critical aspect to consider. Proper ventilation helps expel trapped heat and moisture from inside the home while allowing fresh air to circulate-an essential process in any humid environment. Systems equipped with energy recovery ventilators (ERVs) or heat recovery ventilators (HRVs) are especially beneficial as they recover energy from exhausted air to pre-condition incoming fresh air without losing cooling or heating efficiency.

Lastly, smart thermostats provide an additional layer of convenience and control over climate settings within mobile homes located in coastal regions. These devices allow homeowners to monitor and adjust temperature settings remotely via smartphone apps which can be particularly useful during fluctuating weather conditions typical of coastal areas.

In conclusion, choosing an HVAC system tailored specifically for high-humidity environments is essential for achieving optimal comfort and safeguarding against potential damage caused by excess moisture in mobile homes located near coastlines. By prioritizing features such as advanced dehumidification technology, variable speed operation, effective filtration methods, proper ventilation solutions, and smart thermostat integration-residents can ensure their living spaces remain comfortable year-round while protecting their investment from climatic challenges unique to these scenic yet demanding locales.

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Techniques for Mapping Duct Layouts

Title: Strategies for Optimizing Climate Control in Mobile Homes for Coastal Humidity

Living in a mobile home by the coast offers breathtaking views and a serene lifestyle, yet it also poses unique challenges, especially when it comes to managing humidity. Coastal environments are notorious for their high moisture levels, which can lead to discomfort and potential damage if not properly addressed. Therefore, optimizing climate control in these mobile homes becomes essential.

Firstly, understanding the nature of coastal humidity is crucial. The proximity to large bodies of water means that air naturally has higher moisture content. This can lead to condensation issues within the home, resulting in mold growth and structural deterioration over time. Therefore, any effective strategy must begin with mitigation of excess moisture.

One effective approach is investing in a high-quality dehumidifier. Dehumidifiers help extract moisture from the air, reducing overall humidity levels inside the home. By maintaining an optimal range of 30-50% relative humidity, residents can enjoy a more comfortable living environment while protecting their home from potential water-related damages.

Insulation also plays a pivotal role in regulating indoor climate. Proper insulation not only guards against external temperature fluctuations but also minimizes drafts that can carry moist ocean air indoors. When insulating a mobile home on the coast, materials such as spray foam or fiberglass should be considered due to their effectiveness at sealing gaps and preventing unwanted airflow.

Ventilation is another aspect that cannot be overlooked. Mobile homes need adequate ventilation systems to circulate fresh air while expelling humid indoor air. Installing exhaust fans in key areas like kitchens and bathrooms can significantly help manage indoor moisture levels by directing humid air outside before it has the chance to settle.

Additionally, choosing suitable window treatments can make a difference. Windows are common entry points for humid air; therefore, using double-glazed windows or applying window films can provide an extra barrier against external conditions. Heavy curtains or thermal blinds further enhance this protection by providing an additional layer of insulation.

Moreover, leveraging smart technology can offer precise control over indoor climates. Smart thermostats and hygrometers allow homeowners to monitor temperature and humidity levels remotely and make necessary adjustments instantly. These devices often integrate with other smart home systems, creating an automated response system that proactively manages interior conditions based on real-time data.

Finally, regular maintenance checks are imperative for ensuring all systems function optimally year-round. Inspecting seals around doors and windows for leaks or cracks prevents unnecessary exposure to damp coastal air. Likewise, routine servicing of HVAC systems ensures they operate efficiently without contributing excess heat or moist air into living spaces.

In conclusion, while living in a coastal mobile home presents its own set of challenges regarding humidity management, there are numerous strategies homeowners can employ to maintain comfortable and safe indoor environments. By combining technological solutions with traditional methods like insulation improvement and enhanced ventilation practices, it's possible not only to combat coastal humidity effectively but also fully enjoy the beauty these locations have to offer without compromising comfort or safety inside one's mobile sanctuary.

Tools and Technologies for Accurate Duct Mapping

In the unique environment of coastal regions, where humidity levels can be particularly high, maintaining an optimal climate within mobile homes presents a distinct challenge. Mobile homes, often more vulnerable to external weather conditions than permanent structures, rely heavily on efficient HVAC systems to ensure comfort and air quality. Regular maintenance and upgrades of these systems are not just advisable but essential for achieving desired efficiency and resilience.

The primary function of an HVAC system in any home is to regulate temperature and humidity, creating a comfortable living space regardless of the conditions outside. In coastal areas, this task becomes even more critical due to the constant battle against moisture-laden air that can lead to mold growth and structural deterioration. Without regular attention, an HVAC system can quickly become overwhelmed by these demands, leading to decreased efficiency and higher energy costs.

Regular maintenance serves as the first line of defense against such inefficiencies. It involves routine checks and servicing that keep the system running smoothly. By regularly replacing filters, cleaning ducts, and inspecting components for wear and tear, homeowners can prevent minor issues from escalating into major problems that compromise the entire system's performance. Moreover, consistent maintenance helps extend the life span of HVAC units-a crucial consideration given their significant investment cost.

Upgrades play a pivotal role alongside maintenance in enhancing HVAC efficiency in mobile homes situated in humid coastal climates. Technological advancements have led to the development of highly efficient systems designed specifically to handle increased moisture levels while consuming less energy. Upgrading older units to these advanced models can dramatically improve indoor air quality and reduce electricity bills. Features like variable-speed blowers and smart thermostats allow for better control over indoor environments by adjusting airflow precisely according to real-time conditions.

Additionally, integrating dehumidifiers with existing systems is a strategic move for those battling persistent humidity issues along coastlines. These devices work hand-in-hand with HVAC units to extract excess moisture from the air before it circulates through living spaces-preventing mold proliferation and maintaining healthier indoor environments.

Ultimately, ensuring regular maintenance and considering timely upgrades are investments in both comfort and sustainability for mobile homeowners facing coastal humidity challenges. Not only do these practices enhance day-to-day living conditions by optimizing climate control capabilities; they also contribute significantly towards reducing long-term costs associated with energy consumption and potential repair needs caused by neglected upkeep.

In conclusion, as we seek ways to adapt our living spaces responsibly amidst changing environmental patterns-particularly in vulnerable settings like coastal areas-it becomes increasingly clear that proactive measures around HVAC care are indispensable. Regular maintenance combined with thoughtful upgrades ensures mobile homes remain sanctuaries against the elements outside-a place where efficiency meets comfort regardless of what nature brings forth at sea level's edge.

Best Practices for Cleaner Airflow

Adjusting climate control in mobile homes, especially those situated in coastal areas, presents unique challenges due to high humidity levels. Mobile homes often lack the robust insulation and structural design of traditional houses, making them more susceptible to the effects of humid climates. Therefore, selecting the right dehumidifiers and air conditioners becomes essential for maintaining a comfortable and healthy living environment.

Coastal regions are notorious for their high humidity levels, which can lead to discomfort and potential health issues such as mold growth and respiratory problems. In mobile homes, these issues are exacerbated by limited space and ventilation options. This is where dehumidifiers play a crucial role. A well-chosen dehumidifier can efficiently reduce moisture levels in the air, preventing the buildup of mold and mildew while also reducing allergens like dust mites.

When selecting a dehumidifier for a mobile home, it is important to consider its capacity relative to the size of your space. Smaller units may be ideal for compact areas but might struggle in larger spaces or during peak humidity periods. Conversely, oversized units could lead to unnecessary energy consumption. Additionally, features such as auto-shutoff, continuous drainage options, and energy efficiency ratings should be evaluated to ensure both convenience and cost-effectiveness.

Air conditioners serve a dual purpose by cooling the home while also removing excess moisture from the air-a critical function in humid environments. However, not all air conditioners are equally effective at dehumidification. When choosing an air conditioner for a mobile home on the coast, it's crucial to select one with a strong dehumidification feature or consider investing in a unit specifically designed for humid climates.

The size and type of air conditioning system must match your home's requirements. Portable units offer flexibility but may not provide sufficient power for larger areas or extreme heat conditions typical in coastal summers. Window units can be efficient but require appropriate installation points that may not always be available in mobile homes.

A ductless mini-split system could be an ideal solution due to its ability to deliver focused cooling with minimal installation disruptions.

Energy efficiency is another key consideration when choosing climate control solutions for mobile homes. Both dehumidifiers and air conditioners should ideally have high Energy Star ratings to ensure lower energy bills while minimizing environmental impact.

In conclusion, managing indoor climate control effectively requires careful selection of both dehumidifiers and air conditioners tailored specifically for coastal humidity challenges faced by mobile homeowners. By considering factors such as capacity, energy efficiency, and specific climate needs when purchasing these appliances, residents can create comfortable living spaces that protect against moisture-related problems-all while staying cool during sweltering summer months along the coastlines they call home.

Case Studies of Improved Air Quality in Mobile Homes

Living in a mobile home near the coast offers the charm of ocean views and a serene lifestyle, but it also presents unique challenges, particularly when it comes to managing humidity. Coastal areas are notorious for their high moisture levels, which can lead to discomfort and potential damage inside mobile homes. Therefore, implementing energy-efficient solutions for managing humidity becomes crucial not only for maintaining comfort but also for preserving the structural integrity of your home.

One effective strategy is enhancing ventilation within the mobile home. Proper ventilation helps in circulating air and reducing moisture accumulation. Installing energy-efficient exhaust fans in kitchens and bathrooms can significantly aid in expelling humid air generated during cooking or showering. Additionally, using ceiling fans can help distribute air more evenly throughout your living space, further minimizing moisture build-up.

Another key solution is investing in energy-efficient dehumidifiers. Dehumidifiers are designed to extract excess moisture from the air, thus creating a more comfortable living environment. Modern dehumidifiers come with energy-saving features such as programmable timers and adjustable humidity settings that allow homeowners to optimize their usage according to specific needs. Selecting an appropriately sized dehumidifier based on your mobile home's square footage ensures maximum efficiency without unnecessary energy consumption.

Insulation plays a pivotal role in controlling both temperature and humidity levels inside a mobile home. High-quality insulation materials help prevent external humid air from infiltrating while retaining conditioned air indoors, reducing the workload on climate control systems. Homeowners should consider upgrading windows and doors with double-glazed options that offer better insulation properties compared to traditional single-pane designs.

Furthermore, smart climate control systems have revolutionized how we manage indoor environments efficiently. These systems allow homeowners to monitor and adjust temperature and humidity levels remotely via smartphone apps or other digital interfaces. By utilizing sensors and intelligent algorithms, these systems can automatically adjust settings based on real-time weather conditions or occupancy patterns, ensuring optimal comfort without wasting energy.

Lastly, incorporating natural elements like houseplants can be an eco-friendly way to regulate humidity levels while adding aesthetic value to your home interior. Certain plants such as peace lilies or ferns naturally absorb moisture from the air through their leaves-a process known as transpiration-thus contributing to a balanced indoor climate.

In conclusion, addressing coastal humidity challenges in mobile homes requires a multifaceted approach combining technology with thoughtful design choices aimed at conserving energy while enhancing comfort. By investing in advanced ventilation systems, efficient dehumidifiers, proper insulation techniques alongside modern climate controls-and even embracing nature's own solutions-you create an environment that withstands coastal conditions gracefully while minimizing ecological impact-a win-win scenario for both homeowner satisfaction and environmental sustainability 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).

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

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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

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

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
- Image not found or type unknown Category
- Image not found or type unknown icon Renewable energy portal

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

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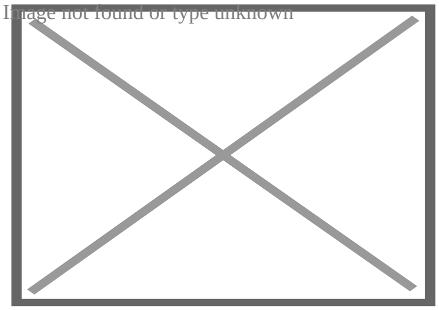

A: indoor compartment, B: outdoor compartment, I: insulation, 1: condenser, 2: expansion valve, 3: evaporator, 4: compressor

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: $W=\frac{Q}{\mathrm{COP}}$ Image not found or type unknown where

- W Image not found or type unknown is the work performed on the working fluid by the heat pump's compressor.
- Q Image not found or type unknown is the heat transferred from the lower-temperature reservoir to the higher-temperature reservoir.
- COP Image not found or type unknown 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.

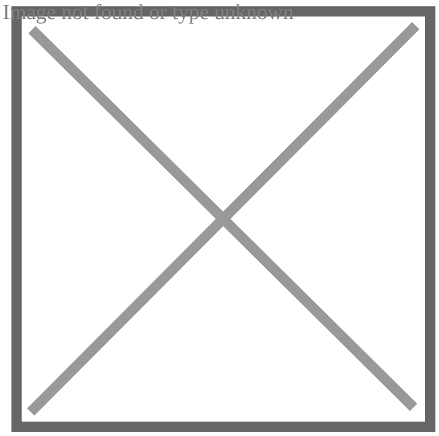
Types

[edit]

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]

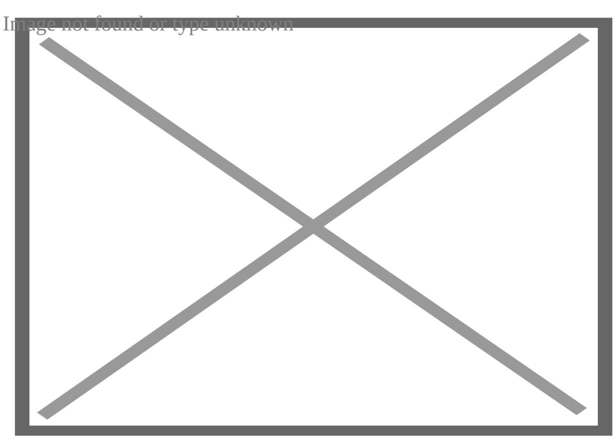
Air-source heat pumps are relatively easy and inexpensive to install, so are the most widely used type. In mild weather, coefficient of performance (COP) may be between 2 and 5, while at temperatures below around −8 °C (18 °F) an air-source heat pump may still achieve a COP of 1 to 4.[25]

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

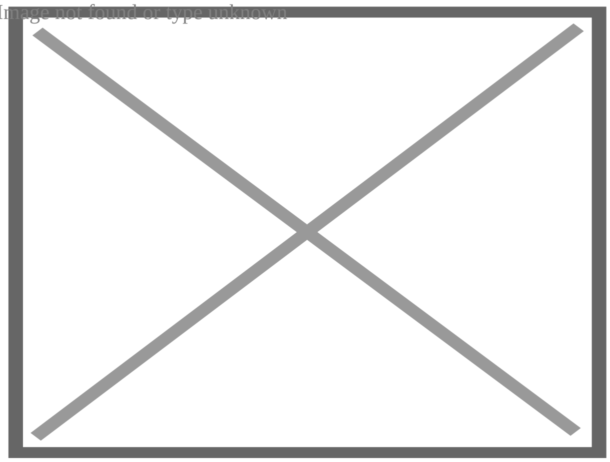
Exhaust air heat pumps extract heat from the exhaust air of a building and require mechanical ventilation. Two classes exist:

- 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]



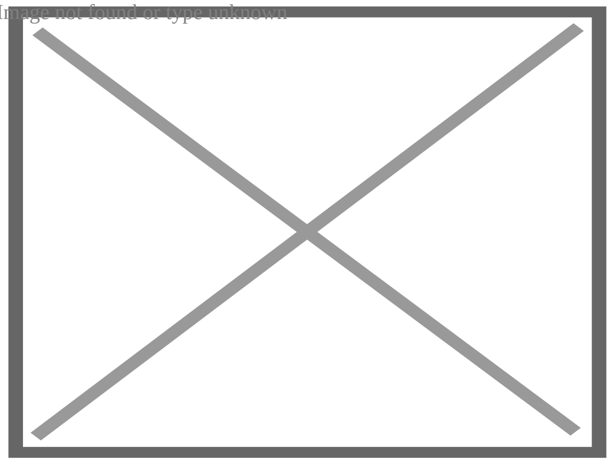
Hybrid photovoltaic-thermal solar panels of a SAHP in an experimental installation at Department of Energy at Polytechnic of Milan

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]

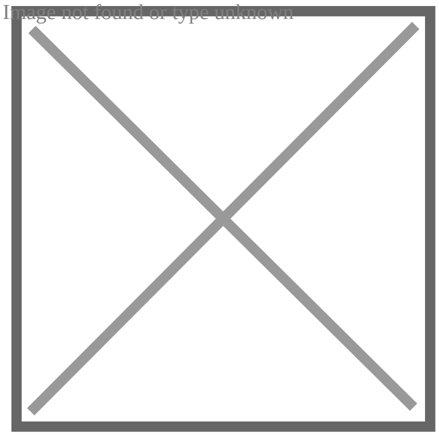
In HVAC applications, a heat pump is typically a vapor-compression refrigeration device that includes a reversing valve and optimized heat exchangers so that the direction of *heat flow* (thermal energy movement) may be reversed. The reversing valve switches the direction of refrigerant through the cycle 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 CO_2 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	Ã�Æ'Ã�â€™Ã�â€ Ã¢â‚¬â„¢Ã�Æ'Ã¢â‚¬Â Ã�Â¢Ã¢â€�Â¬Ã¢â€�
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

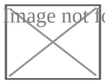
In most settings, heat pumps will reduce CO_2 emissions compared to heating systems powered by fossil fuels.[62] In regions accounting for 70% of world energy consumption, the emissions savings of heat pumps compared with a high-efficiency gas boiler are on average above 45% and reach 80% in countries 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



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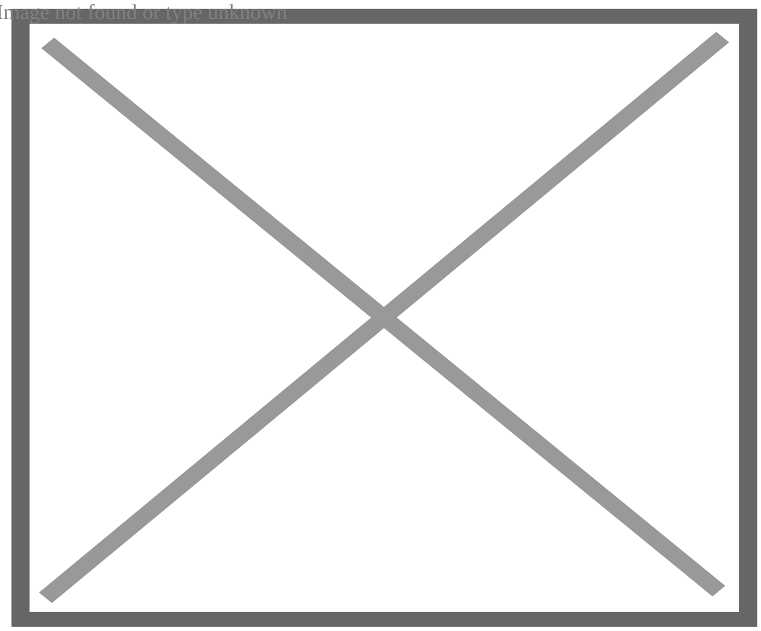
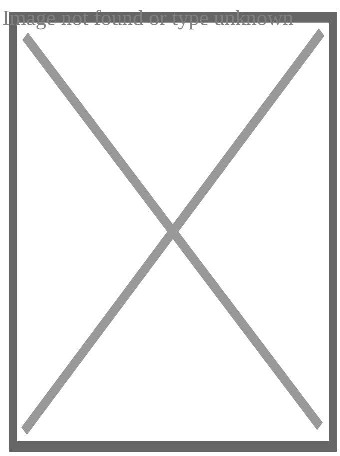
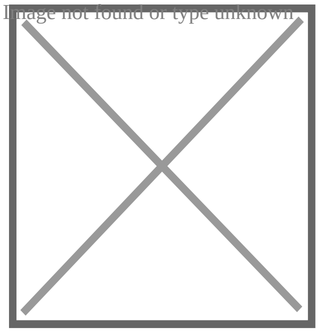


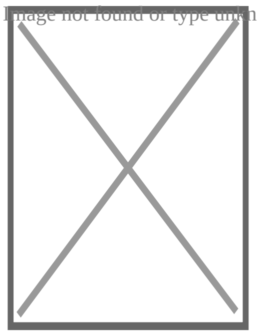
Figure 2: Temperature–entropy diagram of the vapor-compression cycle



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 that 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 (NH_3), carbon dioxide (CO_2), and water (H_2

$_2O$)[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 needed*] 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 CO_2 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 CO_2, 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]

1. **^** As explained in Coefficient of performance TheoreticalMaxCOP = (desiredIndoorTempC + 273) ÷ (desiredIndoorTempC − outsideTempC) = (7+273) ÷ (7 − (−3)) = 280÷10 = 28 [10]
2. **^** As explained in Coefficient of performance TheoreticalMaxCOP = (desiredIndoorTempC + 273) ÷ (desiredIndoorTempC − outsideTempC) = (27+273) ÷ (27 − (−3)) = 300÷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

- 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

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

Professions, trades, and services	◦ Architectural acoustics ◦ Architectural engineering ◦ Architectural technologist ◦ Building services engineering ◦ Building information modeling (BIM) ◦ Deep energy retrofit ◦ 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
Health and safety	◦ Indoor air quality (IAQ) ◦ Passive smoking ◦ Sick building syndrome (SBS) ◦ Volatile organic compound (VOC)

See also

- ASHRAE Handbook
- Building science
- Fireproofing
- Glossary of HVAC terms
- Warm Spaces
- World Refrigeration Day
- Template:Home automation
- Template:Solar energy

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Things To Do in Tulsa County

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Reviews for Durham Supply Inc

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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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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

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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!

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!

Adjusting Climate Control in Mobile Homes for Coastal Humidity**View GBP**

Royal Supply Inc

Phone : +16362969959

City : Oklahoma City

State : OK

Zip : 73149

Address : Unknown Address

Google Business Profile

Company Website : **https://royal-durhamsupply.com/locations/oklahoma-city-oklahoma/**

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