



- **Understanding SEER Ratings for Mobile Home Cooling**  
Understanding SEER Ratings for Mobile Home Cooling Tracking Power Usage in Mobile Home Heating Systems Adapting Mobile Homes for High Efficiency HVAC Equipment Comparing SEER Values to Lower Energy Costs in Mobile Homes Evaluating ROI of Efficient Upgrades in Mobile Home Air Conditioning Minimizing Heat Loss with Insulation for Mobile Home HVAC Achieving Energy Savings with Variable Speed Motors in Mobile Homes Choosing Thermostat Controls for Better Mobile Home Efficiency Calculating Long Term Benefits of Efficient Mobile Home Furnaces Checking Duct Seal Quality for Improved Mobile Home SEER Performance Pinpointing Energy Loss in Mobile Home HVAC Installations Monitoring Seasonal Impacts on Mobile Home AC Efficiency
- **Exploring Common Certifications Required for Mobile Home HVAC Service**  
Exploring Common Certifications Required for Mobile Home HVAC Service Understanding EPA Regulations for Mobile Home Cooling Systems Evaluating Technician Training Programs for Mobile Home Heating Examining NATE Credentials and What They Mean for Mobile Home Repair Verifying Local Licensing for Mobile Home HVAC Professionals Assessing Safety Knowledge in Mobile Home Technician Work Matching Skill Levels to Complex Mobile Home AC Installations Identifying Gaps in Technical Training for Mobile Home HVAC Work Learning About Continuing Education for Mobile Home Furnace Repair Validating Experience Through Field Tests in Mobile Home HVAC Exploring Online Resources for Mobile Home Technician Readiness Collaborating with Certified Professionals for Mobile Home HVAC Projects
- **About Us**



# Examining NATE Credentials and What They Mean for Mobile Home Repair

## How SEER Ratings Impact Energy Efficiency in Mobile Homes

Mobile home HVAC systems present a unique set of challenges and features that significantly differ from those found in traditional residential settings. Understanding these differences is crucial for homeowners and repair professionals alike, especially when examining the role of North American Technician Excellence (NATE) credentials in ensuring effective mobile home repair.

Mobile homes, often referred to as manufactured homes, are typically smaller and more compact than traditional houses. This structural difference means that their HVAC systems must be specifically designed to fit into tighter spaces while still delivering efficient heating and cooling. One key feature of mobile home HVAC systems is their ductwork; it tends to be narrower and may run through the floor rather than the ceiling or walls. This can lead to unique airflow challenges such as restricted air movement or uneven temperature distribution throughout the home.

Additionally, mobile homes often face greater exposure to outdoor elements due to less insulation compared to site-built homes. Thermostat settings should be adjusted seasonally for maximum efficiency **mobile home hvac replacement cost** ceiling. This can result in higher energy demands on the HVAC system, necessitating robust performance even under challenging conditions. Moreover, given their design, these units may require specialized components like package units or specific types of heat pumps tailored to meet their spatial constraints.

The intricacies involved in maintaining or repairing mobile home HVAC systems underscore the importance of professional expertise, which brings us to NATE credentials. The North American Technician Excellence certification is a mark of excellence within the HVAC industry. Technicians who earn NATE credentials have demonstrated significant knowledge

in heating, ventilation, air conditioning, and refrigeration services through rigorous testing.

For mobile home repairs specifically, NATE-certified technicians bring an added layer of assurance. Their training equips them with a comprehensive understanding of various system types and configurations-including those peculiar to mobile homes-enabling them to diagnose issues accurately and implement solutions effectively. Beyond technical proficiency, NATE certification also signifies a commitment to continual learning and adherence to industry standards-a critical consideration given the evolving nature of HVAC technologies.

In conclusion, while mobile home HVAC systems pose distinctive challenges due to their size constraints and environmental exposure, leveraging skilled professionals with NATE credentials can make all the difference. These certified experts not only possess specialized knowledge but also uphold high standards that ensure reliable repairs and maintenance-a vital factor for keeping any mobile home's climate control system running smoothly year-round.

In the realm of mobile home HVAC repairs, ensuring the highest standards of service and expertise is crucial for maintaining comfort and safety. One way to guarantee such quality is by employing NATE-certified technicians. The North American Technician Excellence (NATE) certification holds significant weight in the HVAC industry, representing a technician's commitment to excellence and proficiency.

NATE certification is a rigorous process that requires technicians to demonstrate extensive knowledge and skills in their field. This credential is not merely a testament to passing an exam; it reflects a comprehensive understanding of various HVAC systems, including those specific to mobile homes. Mobile homes present unique challenges due to their compact size, varying construction materials, and often older systems that require specialized attention. A NATE-certified technician brings confidence when tackling these complexities, armed with up-to-date training on the latest technologies and best practices.

For mobile home residents seeking repair or maintenance services, selecting a NATE-certified technician ensures that they are entrusting their system to someone with proven competence. These technicians have undergone continuous education and testing, which means they stay abreast of evolving industry standards and innovations. This ongoing learning process helps them address issues efficiently and effectively, minimizing downtime and potential costs for homeowners.

Moreover, NATE-certified professionals emphasize safety-a critical aspect when dealing with HVAC systems in mobile homes where space constraints can pose additional risks. Proper installation and maintenance reduce hazards like carbon monoxide leaks or electrical failures, safeguarding both the inhabitants' well-being and their property investment.

Beyond technical skills, NATE certification also underscores a commitment to customer service excellence. Certified technicians are trained not only in solving mechanical problems but also in communicating effectively with clients about system issues, necessary repairs, or preventive measures. This transparency builds trust between service providers and homeowners-an invaluable component of any successful repair experience.

In conclusion, the role of NATE-certified technicians in mobile home HVAC repairs cannot be overstated. Their credentials signify more than just technical prowess; they embody a dedication to quality service delivery that prioritizes safety, efficiency, and customer satisfaction. For any mobile homeowner seeking reliable HVAC solutions, choosing a NATE-certified professional ensures peace of mind knowing that their home's comfort system is in capable hands.

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Mobile Home Air Conditioning Installation Services



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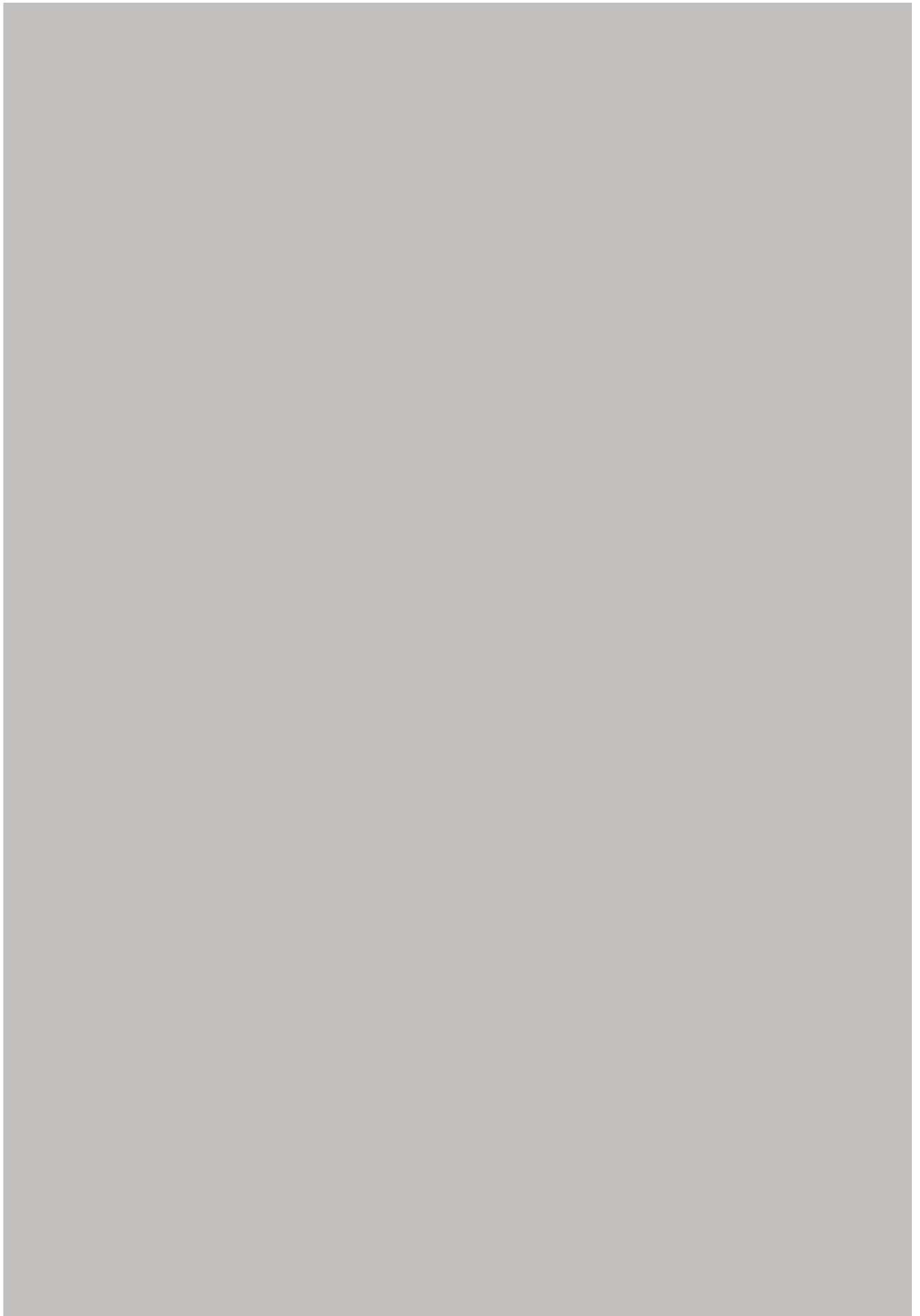
Mobile Home Hvac Service



## **How to reach us**

Mobile Home Hvac Repair





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# Choosing the Right SEER Rating for Your Mobile Home HVAC System

When it comes to maintaining the HVAC systems in mobile homes, hiring professionals with NATE certification can offer significant advantages. The North American Technician Excellence (NATE) certification is a highly regarded credential in the HVAC industry, representing a technician's proficiency and commitment to quality service. Understanding the benefits of employing NATE-certified individuals can help mobile home owners ensure their HVAC systems operate efficiently and reliably.

Firstly, NATE-certified professionals have undergone rigorous testing to demonstrate their knowledge and skills in various areas of HVAC service. This means they are well-equipped to handle the unique challenges that mobile home HVAC systems present. These systems often require specialized attention due to their compact design and specific installation requirements. By hiring a technician with verified expertise, homeowners can be confident that maintenance tasks will be performed correctly and efficiently.

Moreover, NATE certification signifies a commitment to ongoing education and staying updated with industry advancements. The HVAC field is continuously evolving with new technologies and methods for improving energy efficiency and system performance. NATE-certified technicians are required to recertify periodically, ensuring they remain knowledgeable about the latest trends and best practices. This dedication translates into more informed recommendations for repairs or upgrades, potentially saving homeowners money on energy bills through improved system efficiency.

Additionally, hiring a NATE-certified professional for mobile home HVAC maintenance can enhance safety and reliability. Mobile homes have distinct structural characteristics that necessitate careful handling of heating, ventilation, and air conditioning units. A certified technician understands these nuances and follows industry standards rigorously, reducing the risk of accidents or system failures that might result from improper servicing.

Furthermore, using certified professionals increases customer satisfaction due to their proven track record of competence and professionalism. Homeowners benefit from peace of mind knowing that their investment is protected by individuals who meet high standards of excellence. This assurance is particularly valuable when unexpected issues arise or when performing regular maintenance checks aimed at preventing future problems.

In conclusion, examining NATE credentials reveals why they are an important consideration for anyone seeking reliable mobile home repair services. The benefits of hiring NATE-certified professionals include technical expertise tailored to unique needs, access to up-to-date

industry knowledge, enhanced safety protocols, improved system efficiency, and greater overall satisfaction with service outcomes. For those looking to maintain optimal conditions within their mobile homes' living environments through effective HVAC management strategies-choosing certified experts is indeed a wise decision.



## **Factors Influencing SEER Rating Effectiveness in Mobile Homes**

The North American Technician Excellence (NATE) certification is a vital credential for HVAC professionals, signifying a high level of competence and expertise in the field. For those involved in mobile home repair, particularly concerning HVAC systems, understanding the significance of NATE exams can be pivotal. These exams ensure that technicians possess the necessary knowledge and skills to effectively address the unique challenges presented by mobile home HVAC systems.

Mobile homes often have distinct heating and cooling needs compared to traditional homes, primarily due to their size, structure, and materials used in construction. As such, they require specialized attention from technicians who are well-versed in these differences. This is where NATE credentials become highly relevant; they provide assurance that a technician has been rigorously tested on their ability to handle such specific tasks.

Key NATE exams pertinent to mobile home HVAC systems include tests on air conditioning, heat pumps, gas furnaces, oil furnaces, and air distribution. Each exam area targets critical competencies necessary for effective mobile home HVAC maintenance and repair.

1. **Air Conditioning Exam:** This exam evaluates a technician's ability to install and service various air conditioning systems. Given the compact nature of mobile homes, efficient air conditioning is crucial for maintaining comfortable living conditions without excessive energy use.
2. **Heat Pumps Exam:** Heat pumps are commonly used in mobile homes because of their efficiency in both heating and cooling operations. The NATE heat pumps exam measures a technician's proficiency in installing and servicing these systems-a skill set essential for ensuring optimal indoor climates throughout the year.
3. **Gas Furnaces Exam:** Many mobile homes rely on gas furnaces for heating during colder months. The corresponding NATE exam covers installation techniques as well as troubleshooting methods tailored to these units' characteristics within confined spaces

typical of mobile homes.

4. **Oil Furnaces Exam:** Although less common than gas furnaces today, oil furnaces still play an important role in some regions or older models of mobile homes. The exam tests knowledge relevant to this technology's maintenance requirements and problem-solving strategies applicable within smaller residential environments.
  
5. **Air Distribution Exam:** Effective air distribution is vital in any HVAC system but poses unique challenges within narrower confines like those found inside most manufactured housing units-especially when ductwork must navigate tight quarters while minimizing noise levels or inefficiencies due largely due space constraints inherent part design considerations related specifically towards maximizing livable areas available occupants themselves over time frames ranging anywhere between short-term stays upwards several decades depending circumstances surrounding individual owners' personal preferences at point purchase initially made prior moving day arrives finally come fruition later date down line further along journey life itself perhaps!

In conclusion,

Holding NATE certification signifies not only technical proficiency but also dedication toward professional growth continuous learning endeavors critical success industry professionals engaged directly indirectly alike manner possible given ever-changing landscape evolving technologies emerging trends shaping future marketplace demand services rendered end users clients each every single day basis worldwide scale dynamic fashion unprecedented times witnessed history mankind overall humanity taken whole perspective considered viewpoint subjective objective simultaneously looking forward positive outcomes achieved shared goals collectively aimed reaching apex innovation excellence performance standards set forth guiding principles core values embraced wholeheartedly community stakeholders participating actively contributing meaningfully significant capacity roles assigned designated individuals groups organizations agencies governmental non-governmental sectors partnerships collaborations initiatives undertaken jointly collaboratively mutually beneficial arrangements fostered nurtured cultivated sustained ongoing efforts geared achieving mutual prosperity satisfaction peace harmony sustainable development advancement betterment society general welfare wellbeing larger context global citizenry interconnected interdependent

world lived inhabited presently momentous occasion remember cherish appreciate fully  
tomorrow brings newfound opportunities challenges await eagerly anticipated warmly

# Comparing SEER Ratings Across Different Mobile Home Cooling Systems

The world of mobile home HVAC services is one that demands precision, reliability, and high standards of quality. Given the unique challenges associated with heating, ventilation, and air conditioning in mobile homes-such as limited space and varying insulation levels-the need for certified professionals becomes even more crucial. This is where NATE certification comes into play, acting as a hallmark of excellence and dependability.

NATE, or North American Technician Excellence, is the leading certification program for technicians in the heating, ventilation, air conditioning, and refrigeration (HVACR) industry. Earning a NATE certification signifies that a technician has achieved the highest level of expertise and competency in their field. But what exactly does this mean for mobile home repair?

First and foremost, NATE-certified technicians have demonstrated thorough knowledge through rigorous testing procedures that cover a wide range of HVAC systems and components. For mobile home owners seeking repairs or installations, hiring a NATE-certified professional ensures that the technician possesses an in-depth understanding of specific system requirements pertinent to mobile homes. This specialized knowledge helps prevent common issues such as improper installation or mismatched system components which can lead to inefficiency or even system failure.

Moreover, NATE certifications are not static; they require periodic renewal through continued education and testing. This ongoing process guarantees that certified technicians stay up-to-



date with the latest advancements in technology and techniques within the HVAC industry. In an era where technological innovations occur rapidly, this commitment to continuous improvement assures customers that they are receiving services informed by current best practices.

Another key aspect of NATE certification is its focus on customer satisfaction and service excellence. Technicians who achieve this certification have proven their ability to assess problems accurately and provide effective solutions efficiently-a critical factor when dealing with climate control systems where time-sensitive repairs can significantly impact comfort levels within a home.

Furthermore, employing NATE-certified technicians can also offer peace of mind regarding safety standards. Mobile homes often pose distinct safety challenges due to their construction materials and design; thus it's vital that any repair work complies with stringent safety protocols to minimize risk factors such as fire hazards or carbon monoxide leaks.

In conclusion, opting for NATE-certified professionals when addressing HVAC needs in mobile homes ensures access to skilled experts who are dedicated not only to maintaining high-quality standards but also committed to delivering reliable results consistently. By prioritizing these credentials during your selection process for HVAC services you can be confident in both short-term successes like efficient repairs as well as long-term benefits including prolonged equipment lifespan- ultimately fostering greater peace-of-mind about your investment into maintaining optimal living conditions within your mobile home environment.

## **Tips for Maintaining Optimal Performance of High-SEER Rated Systems**



In recent years, the mobile home industry has experienced a significant transformation, driven by advancements in technology and an increased focus on efficiency and performance. At the heart of this evolution is the role of NATE-certified technicians, who are setting new standards for excellence in mobile home repair and maintenance. Through case studies, we can see how these highly qualified professionals contribute to improved outcomes in mobile homes, ensuring comfort, safety, and reliability for residents.

NATE, or North American Technician Excellence, is a certification program that stands as a benchmark for technical proficiency within the HVAC (heating, ventilation, and air conditioning) industry. For mobile home owners and operators, employing NATE-certified technicians means entrusting their investments to individuals who have undergone rigorous training and testing. This credential signifies not only technical expertise but also a commitment to staying updated with industry best practices.

One compelling success story involves a mobile home community in Florida that faced persistent issues with inefficient air conditioning systems. With residents enduring unbearable heat during summer months due to frequent breakdowns and subpar repairs by uncertified workers, the community management decided to hire NATE-certified technicians. The outcome was transformative; these technicians conducted thorough assessments, identified key inefficiencies in the existing systems, and implemented targeted solutions. By optimizing air flow designs and upgrading outdated components with high-efficiency alternatives, energy consumption was significantly reduced while enhancing system reliability. Residents reported noticeable improvements in indoor comfort levels alongside lower utility bills—a win-win scenario facilitated by certified expertise.

Another example hails from a Midwest mobile home park grappling with recurring heating failures during harsh winters. Previous attempts at repairs had proven ineffective until NATE-certified professionals were brought on board. These experts not only repaired malfunctioning units but also educated residents on proper maintenance techniques crucial for long-term functionality—demonstrating how knowledge transfer plays an integral part in sustainable solutions.

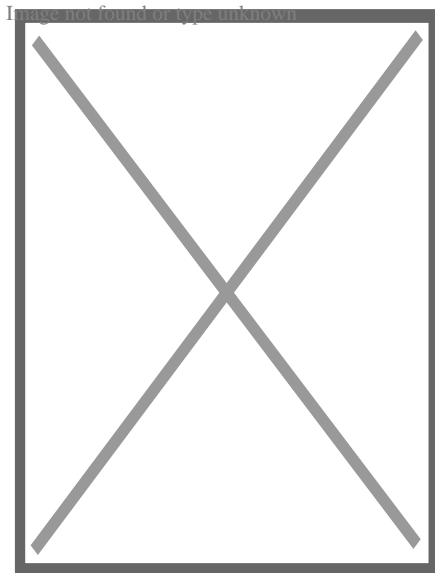
These case studies underscore why examining NATE credentials is essential when considering mobile home repairs or upgrades: they assure quality workmanship backed by deep-rooted understanding of complex HVAC systems tailored specifically towards manufactured housing environments—a niche requiring specialized knowledge often beyond generalist capabilities.

Moreover, engaging certified technicians fosters trust between service providers and clients-a critical aspect given that many homeowners may lack technical acumen needed for informed decision-making about their properties' infrastructure needs. Knowing that work performed adheres strictly to established guidelines provides peace-of-mind regarding both immediate results achieved through interventions as well assurance against unforeseen complications down line resulting from improper handling initially.

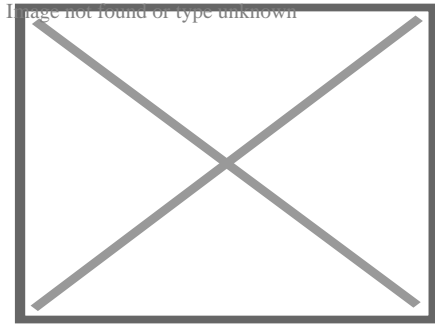
In conclusion,NATE certification represents more than just technical ability; it embodies dedication towards elevating standards across industries reliant upon skilled tradespeople such those involved maintaining improving living conditions within rapidly evolving contexts like modern-day modular dwellings.As demonstrated successful deployments described above ,investing services offered accredited practitioners yields tangible benefits not only enhancing operational efficiencies reducing costs over time but ultimately enriching lives those residing therein through superior performance delivered consistently high levels professionalism integrity throughout process .

## 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
-  Category
-  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.<sup>[1]</sup> 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.<sup>[2]</sup>

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.

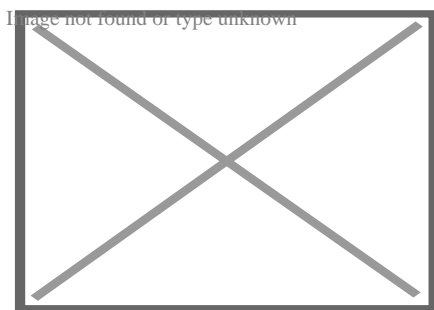
Air source heat pumps are the most common models, while other types include ground source heat pumps, water source heat pumps and exhaust air heat pumps.<sup>[3]</sup> Large-scale heat pumps are also used in district heating systems.<sup>[4]</sup>

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.<sup>[5]</sup><sup>[6]</sup> Consuming 1 kWh of electricity, they can transfer 1<sup>[7]</sup> 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.<sup>[8]</sup> 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%.<sup>[4]</sup>

## 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.<sup>[9]</sup>

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:

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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.<sup>[9]</sup>

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.<sup>[note 1]</sup>
- 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.<sup>[note 2]</sup>

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.<sup>[11]</sup>



## History

[edit]

Milestones:

1748

William Cullen demonstrates artificial refrigeration.<sup>[12]</sup>

1834

Jacob Perkins patents a design for a practical refrigerator using dimethyl ether.<sup>[13]</sup>

1852

Lord Kelvin describes the theory underlying heat pumps.<sup>[14]</sup>

1855–1857

Peter von Rittinger develops and builds the first heat pump.<sup>[15]</sup>

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.<sup>[14][16]</sup>

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.<sup>[17]</sup>

1937–1945

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

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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.<sup>[14]</sup>

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.[<sup>18</sup>]

1948

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

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.[<sup>18</sup>]

2019

The Kigali Amendment to phase out harmful refrigerants takes effect.

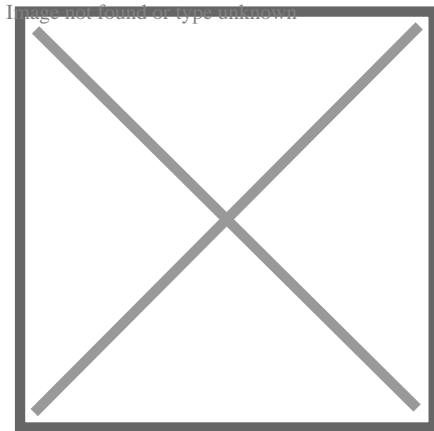
## Types

[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[<sup>20</sup>][<sup>21</sup>]

*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)[<sup>22]</sup>

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.[<sup>23]</sup>

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[<sup>24]</sup>

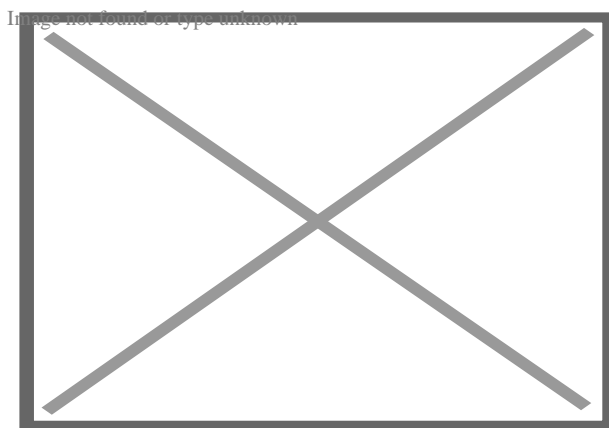
Air-source heat pumps are relatively easy and inexpensive to install, so are the most widely used type. In mild weather, coefficient of performance (COP) may be between 2 and 5, while at temperatures below around -8 °C (18 °F) an air-source heat pump may still achieve a COP of 1 to 4.[<sup>25]</sup>

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.[<sup>26]</sup>

## 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.<sup>[27]</sup> Otherwise air-source heat pumps are often used instead.

### Heat recovery ventilation

[edit]

Main article: Heat recovery ventilation

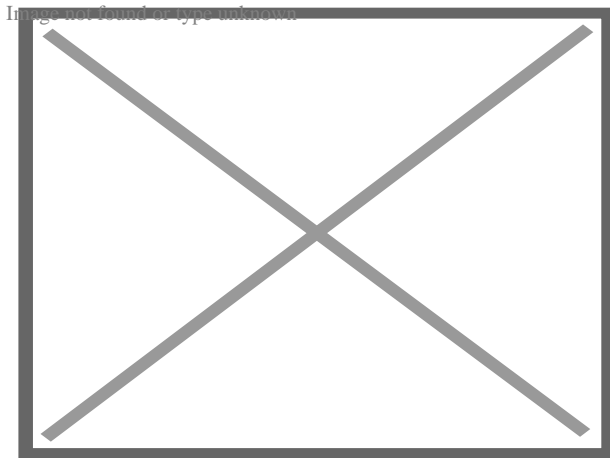
Exhaust air heat pumps extract heat from the exhaust air of a building and require mechanical ventilation. Two classes exist:

- 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]



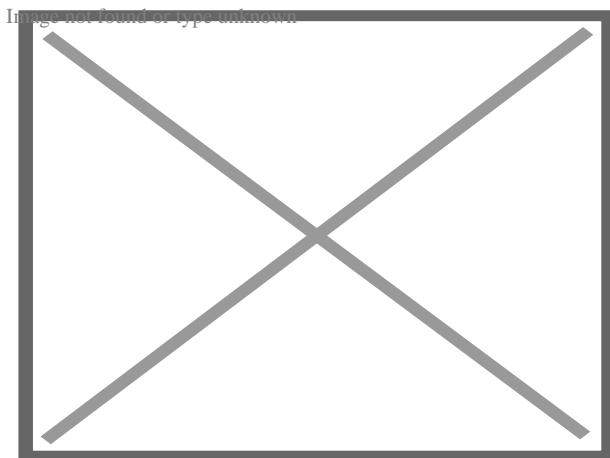
Hybrid photovoltaic-thermal solar panels of a SAHP in an experimental installation at Department of Energy at Polytechnic of Milan

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.<sup>[28]</sup> Typically these two technologies are used separately (or only placing them in parallel) to produce hot water<sup>[29]</sup> ] 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.<sup>[30]</sup> 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.<sup>[31]</sup> The largest water-source heat pump was installed in the Danish town of Esbjerg in 2023.<sup>[32][33]</sup>

## 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.<sup>[34]</sup>

Electrocaloric heat pumps are solid state.<sup>[35]</sup>

## 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.<sup>[4]</sup> They are used for heating, ventilation, and air conditioning (HVAC) and may also provide domestic hot water and tumble clothes drying.<sup>[36]</sup> The purchase costs are supported in various countries by consumer rebates.<sup>[37]</sup>

## Space heating and sometimes also cooling

[edit]

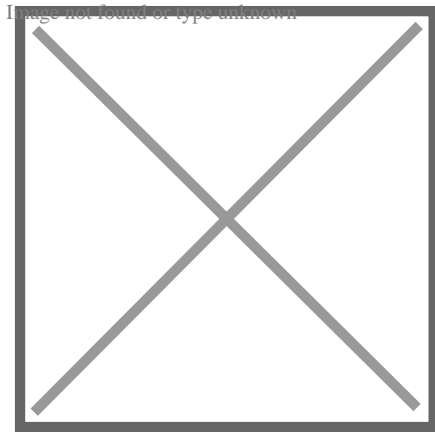
In HVAC applications, a heat pump is typically a vapor-compression refrigeration device that includes a reversing valve and optimized heat exchangers so that the direction of *heat flow* (thermal energy movement) may be reversed. The reversing valve switches the direction of refrigerant through the cycle 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.<sup>[38]</sup>

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.<sup>[39]</sup>

## 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.<sup>[40]</sup>

## 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.<sup>[41]</sup><sup>[42]</sup>

## District heating

[edit]

Large (megawatt-scale) heat pumps are used for district heating.<sup>[43]</sup> However as of 2022 about 90% of district heat is from fossil fuels.<sup>[44]</sup> 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.<sup>[4]</sup> 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.<sup>[45]</sup> 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.<sup>[45][46]</sup> They are also a crucial element of systems which can both heat and cool districts.<sup>[47]</sup>

## 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.<sup>[48][49]</sup> Short payback periods of less than 2 years are possible, while achieving a high reduction of CO<sub>2</sub> emissions (in some cases more than 50%).<sup>[50][51]</sup> Industrial heat pumps can heat up to 200 °C, and can meet the heating demands of many light industries.<sup>[52][53]</sup> In Europe alone, 15 GW of heat pumps could be installed in 3,000 facilities in the paper, food and chemicals industries.<sup>[4]</sup>

## 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*).<sup>[54]</sup> 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.<sup>[54]</sup> Larger values of either metric indicate better performance.<sup>[54]</sup> ] 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.<sup>[54]</sup> 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 <sub>2</sub> (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<sup>[56]</sup>

5.0

GSHP,  
ground at  
10 °C<sup>[56]</sup>

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  
<sub>2</sub> pump),  
return fluid  
25 °C,  
source  
0 °C<sup>[58]</sup>

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 <sub>2</sub> /kWh <sup>[59]</sup>	400% (COP=4)	3 gCO <sub>2</sub> /kWh
heat pump with global electricity mix	436 gCO <sub>2</sub> /kWh <sup>[60]</sup> (2022)	400% (COP=4)	109 gCO <sub>2</sub> /kWh
natural-gas thermal (high efficiency) heat pump	201 gCO <sub>2</sub> /kWh <sup>[61]</sup>	90% <sup>[citation needed]</sup>	223 gCO <sub>2</sub> /kWh
electricity by lignite (old power plant) and low performance	1221 gCO <sub>2</sub> /kWh <sup>[61]</sup>	300% (COP=3)	407 gCO <sub>2</sub> /kWh

In most settings, heat pumps will reduce CO<sub>2</sub> emissions compared to heating systems powered by fossil fuels.<sup>[62]</sup> 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.<sup>[4]</sup> 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<sup>[63]</sup><sup>[4]</sup> The rising share of renewable electricity generation in many countries is set to increase the emissions savings from heat pumps over time.<sup>[4]</sup>

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.<sup>[64]</sup><sup>[65]</sup>

## Operation

[edit]

See also: Vapor-compression refrigeration



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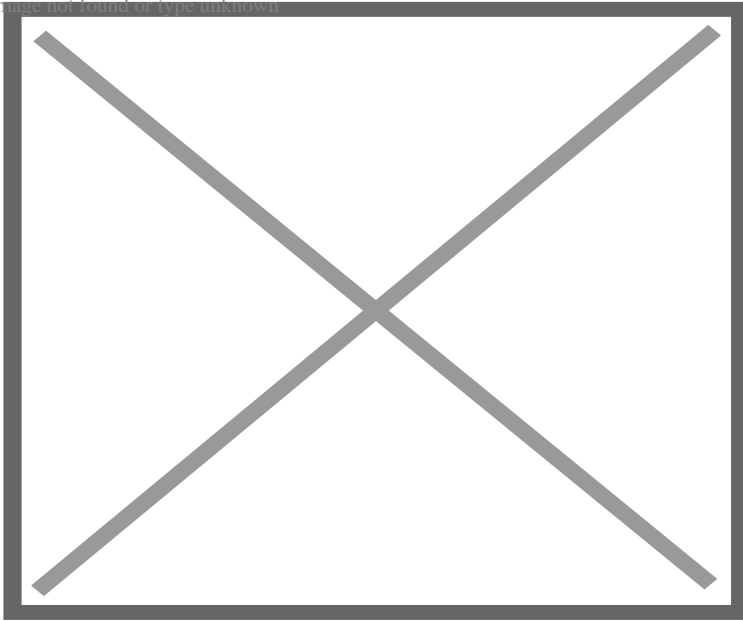
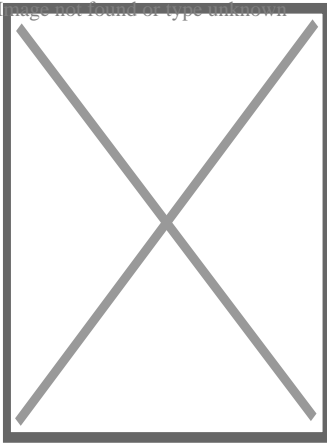


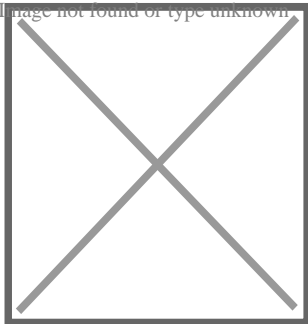
Figure 2: Temperature–entropy diagram of the vapor-compression cycle

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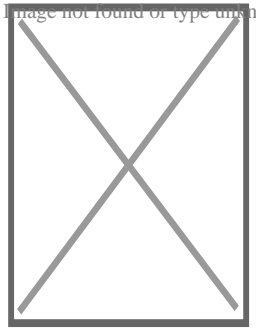


An internal view of the outdoor unit of an Ecodan air source heat pump

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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<sup>[66]</sup> 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.<sup>[67]</sup>

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<sub>3</sub>), carbon dioxide (CO<sub>2</sub>), and water (H<sub>2</sub>O))<sup>[68]</sup>.<sup>[69]</sup> Their boiling points are usually below −25 °C.<sup>[70]</sup>

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,<sup>[clarification]</sup> 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,<sup>[71]</sup> as most countries have now ratified the Kigali Amendment to ban HFCs.<sup>[72]</sup> 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.<sup>[73]</sup> Propane may be the most suitable for high temperature heat pumps.<sup>[74]</sup> Ammonia (R717) and carbon dioxide (R-744) also have a low GWP. As of 2023 smaller CO<sub>2</sub> heat pumps are not widely available and research and development of them continues.<sup>[75]</sup> A 2024 report said that refrigerants with GWP are vulnerable to further international restrictions.<sup>[76]</sup>

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.<sup>[77]</sup>

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

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

Devices with R-290 refrigerant (propane) are expected to play a key role in the future.<sup>[74][85]</sup> 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).<sup>[86][87][88]</sup> 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.<sup>[citation needed]</sup>

At the same time,<sup>[when?]</sup> 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.<sup>[89]</sup> 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<sub>2</sub>, which corresponds to two years of natural gas heating in an average household. Refrigerants with a high ODP have already been phased out.<sup>[citation needed]</sup>

## Government incentives

[edit]

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

## 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.<sup>[91]</sup>

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.<sup>[92][93][94][95][96]</sup>

## Canada

[edit]

In 2022, the Canada Greener Homes Grant<sup>[97]</sup> 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.<sup>[98]</sup>

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.<sup>[99]</sup>

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.<sup>[99]</sup>

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.<sup>[99][100]</sup>

## European Union

[edit]

To speed up the deployment rate of heat pumps, the European Commission launched the Heat Pump Accelerator Platform in November 2024.<sup>[101]</sup> It will encourage industry experts, policymakers, and stakeholders to collaborate, share best practices and ideas, and jointly discuss measures that promote sustainable heating solutions.<sup>[102]</sup>

## 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.<sup>[103]</sup> As of 2022 the installation cost of a heat pump is more than a gas boiler, but

with the "Boiler Upgrade Scheme"[<sup>104</sup>] government grant and assuming electricity/gas costs remain similar their lifetime costs would be similar on average.[<sup>105</sup>] 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.[<sup>106</sup>] In 2024 England was criticised for still allowing new homes to be built with gas boilers, unlike some other counties where this is banned.[<sup>107</sup>]

## 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.[<sup>108</sup>]

In 2022, more heat pumps were sold in the United States than natural gas furnaces[<sup>109</sup>]

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.[<sup>110</sup>]

## Notes

[edit]

- <sup>^</sup> As explained in Coefficient of performance TheoreticalMaxCOP =  $(\text{desiredIndoorTempC} + 273) \div (\text{desiredIndoorTempC} - \text{outsideTempC}) = (7+273) \div (7 - (-3)) = 280 \div 10 = 28$  [<sup>10</sup>]
- <sup>^</sup> As explained in Coefficient of performance TheoreticalMaxCOP =  $(\text{desiredIndoorTempC} + 273) \div (\text{desiredIndoorTempC} - \text{outsideTempC}) = (27+273) \div (27 - (-3)) = 300 \div 30 = 10$  [<sup>10</sup>]

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[edit]

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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

**Health and safety**

- Indoor air quality (IAQ)
- Passive smoking
- Sick building syndrome (SBS)
- Volatile organic compound (VOC)
- ASHRAE Handbook
- Building science
- Fireproofing

**See also**

- Glossary of HVAC terms
- Warm Spaces
- World Refrigeration Day
- Template:Home automation
- Template:Solar energy

**Authority control databases: National**

- Germany
- United States
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Things To Do in Oklahoma County

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Oklahoma City Zoo

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Oklahoma City National Memorial & Museum

4.9 (11628)

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## **Stockyards City Main Street**

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## **Route 66 Park**

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## **National Cowboy & Western Heritage Museum**

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## Model T Graveyard

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**Jennifer Williamson**

**(5)**

First we would like to thank you for installing our air conditioning unit! I'd like to really brag about our technician, Mack, that came to our home to install our unit in our new home. Mack was here for most of the day and thoroughly explained everything we had a question about. By the late afternoon, we had cold air pumping through our vents and we couldn't have been more thankful. I can tell you, I would be very lucky to have a technician like Mack if this were my company. He was very very professional, kind, and courteous. Please give Mack a pat on the back and stay rest assured that Mack is doing a great job and upholding your company name! Mack, if you see this, great job!! Thanks for everything you did!! We now have a new HVAC company in the event we need one. We will also spread the word to others!!

### Durham Supply Inc

Image not found or type unknown

**Salest**

**(5)**

Had to make a quick run for 2 sets of ?? door locks for front and back door.. In/ out in a quick minute! They helped me right away. ?? Made sure the 2 sets had the same ? keys. The ? bathroom was clean and had everything I needed. ? ?. Made a quick inquiry about a random item... they quickly looked it up and gave me pricing. Great ? job ?

### Durham Supply Inc

Image not found or type unknown

**Crystal Dawn**

**(1)**

I would give 0 stars. This isn't THE WORST company for heating and air. I purchased a home less than one year ago and my ac has gone out twice and these people refuse to repair it although I AM UNDER WARRANTY!!!! They say it's an environmental issue and they can't fix it or even try to or replace my warranted air conditioning system.

### Durham Supply Inc

Image not found or type unknown

**K Moore**

**(1)**

No service after the sale. I purchased a sliding patio door and was given the wrong size sliding screen door. After speaking with the salesman and manager several times the issue is still not resolved and, I was charged full price for an incomplete door. They blamed the supplier for all the issues...and have offered me nothing to resolve this.

## Durham Supply Inc

Image not found or type unknown

Noel Vandy

(5)

Thanks to the hard work of Randy our AC finally got the service it needed. These 100 degree days definitely feel long when your house isn't getting cool anymore. We were so glad when Randy came to work on the unit, he had all the tools and products he needed with him and it was all good and running well when he left. With a long drive to get here and only few opportunities to do so, we are glad he got it done in 1 visit. Now let us hope it will keep running well for a good while.

Examining NATE Credentials and What They Mean for Mobile Home Repair [View GBP](#)

## Frequently Asked Questions

**What does NATE stand for, and why is it important for mobile home HVAC repair?**

NATE stands for North American Technician Excellence. It is a certification program that validates the skills and knowledge of HVAC technicians, ensuring they meet industry standards for quality service, crucial for the specific needs of mobile home systems.

**How can having a NATE-certified technician benefit my mobile homes HVAC system?**

A NATE-certified technician can provide reliable diagnostics, efficient repairs, and proper maintenance tailored to your mobile homes unique HVAC requirements, potentially reducing future breakdowns and improving energy efficiency.

**Are there specific NATE certifications relevant to mobile home HVAC systems?**

Yes, while NATE offers various specialty certifications, those most relevant include Air Conditioning, Heat Pumps (Air-to-Air), Gas Furnaces, and Air Distribution—all applicable to common systems found in mobile homes.

**How do I verify if an HVAC technician has valid NATE credentials?**

You can verify a technicians NATE certification by asking to see their certification card or by checking their status through the official NATE website using their ID number.

**Does hiring a non-NATE certified technician affect warranty claims on my mobile homes HVAC system?**

Its possible; some manufacturers may require repairs or installations be performed by certified professionals to uphold warranty terms. Checking your warranty specifics will clarify this requirement.

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## **Google Business Profile**

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

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