Technical installations in properties

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What are technical installations

Technical installations in buildings

A building is just a protection from weather, and allows us to go dry indoors, and free from the wind.
To obtain a decent quality of life requires the existence of heating, plumbing, ventilation, and electricity.
This is what the technical installations are; thanks to them, you can go inside without shoes or socks and without freezing.
You do not need candles or a headlamp, you just turn the switch and the lights come on.

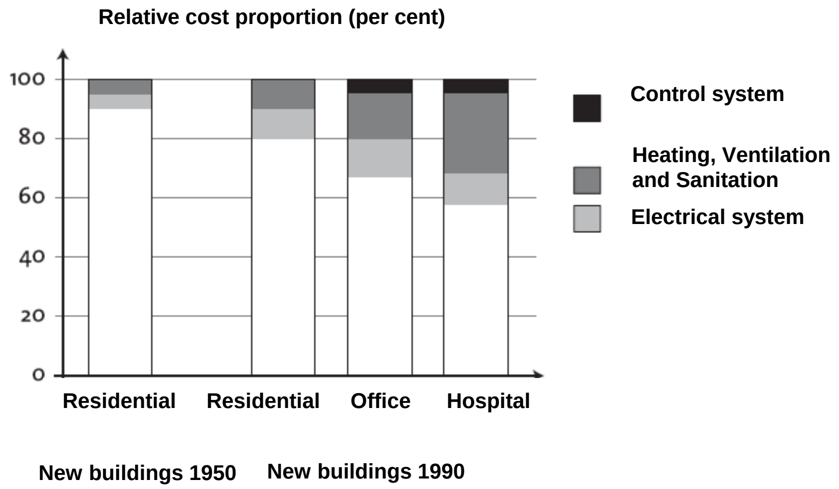
The requirements for the indoor environment have increased over the years
Earlier, we accepted that the indoor temperature varied with the seasons, so even during the winter it was cold indoors.
Today we do not accept it anymore. When it is winter, it ought to be at least 21 degrees Celsius, without having cold feet.

In the future, we will probably require that the temperature will maintain the level of 21 degrees even during the summer; this in turn will involve the installation of cooling systems.

When the requirements from tenants are constantly increasing, better and more sophisticated installations are needed.

The increased requirements have led to the installation of plumbing, electrics, control, and surveillance; they are becoming an increasingly important part of the total construction and operating costs.

In 1950, these facilities accounted for 10% of the total construction cost of homes and commercial premises.
By 1990, these systems accounted for 20% of the total construction cost.



A breakdown of the installation of technical systems of the total construction cost.
Source: The building was in focus. Building and construction of the whole. IVA March 1998

The technical installations have become more sophisticated over the years.
Depending on the building type, there are various systems installed.
In homes, these are the simplest type of buildings, there are: heating systems, sanitary systems, electrical systems, telecommunications, ventilation, data, control systems and elevator systems.

Commercial and community-related buildings are more complex than residential buildings, and they most often have: cooling, sprinklers, and more advanced ventilation and control systems.

The bigger requirement from the tenant means that the client must be knowledgeable in order to make the correct choices for the technical solutions.

Actually, it is really easy to build houses.
Call a contractor and order a building containing 60 apartments.
A year later, you have your house with 60 apartments; the question is whether it was the house you wanted?

Perhaps the implied needs from the tenants were that it should have good thermal comfort in the apartments, without draughts from the windows, and warm floor in the shower.
Moreover, perhaps the location that you built in is known for working systematically with environmental and infrastructure which are an important part of everyday life. Furthermore, add to this the requirement that they want a house that prevents allergies.

How does your newly built house fit those specifications?
Probably not so well.

It is now that the skill of the client comes into play.
The first thing is to find out what the market wants.
Then, what are the opportunities of satisfying the market.
Everything can be offered, but it has a price. It applies to optimizing the operation in relation to revenue.

How will you as the client know what is right.
There are many talented vendors who sell everything from plastic windows to heat pumps that are revolutionary.
This applies to the client to make the assessment what is right and wrong.

If you do not have the expertise, you can ask the experts. These experts are often consultants working in different industries.

The characteristic of a good consultant is the one who can deliver a solution that is right, from the investment and operating cost perspective.
Unfortunately, the consultants have gaps in their knowledge affecting their assessment, from a property manager's perspective.
This places even greater demands on the client.

The consultants are generally good at producing technically advanced solutions that are not always in line with the technical competence held by the operating personnel. You have built a facility that works well and is optimized for building warranty, but what happens then.
When the operating engineer who has previously been explained how to turn on the knobs and make changes, suddenly needs to log on to a computer to see the heat curve and time-channels, then it will be a problem.
In the best case, he sees the settings, but he cannot make adjustments and use the entire capacity of the equipment he is not familiar with.

The choice of system is usually on the basis of construction and installation cost.
Unfortunately, there is no long-term thinking for the selection of ventilation, heating, water, and electrical systems.
In order to make the right choice of systems and equipment, life-cycle costing may be a good model.
With increasing focus on life-cycle cost, the total cost of the building could be reduced, despite an increased initial cost.

Life cycle cost

There are several life cycle-cost models that can be used, two of them are:
LCC, life-cycle cost
LCP, life-cycle profit

The main purpose of using the LCC is to optimize an investment's total cost. Total cost means the cost to build and operate a building during its lifetime.

LCP is the sum of the difference between costs and revenues for the investment's lifetime. Unlike LCC it is the revenue that is the focus where the profitability of the investment will be optimized.

In the selection of installation systems and installation products, it is mainly LCC that is used. The LCC calculation compares the different products with regard to the investment, operating costs, maintenance costs and energy costs.
Since the energy had increased considerably in recent years it has often been the reason why it has performed an LCC calculation.

In Sweden, the housing sector stands for 39% of total energy use. Energy is about the same as in the 70's despite the fact that the number of dwellings has increased by 30%, Energy State (2004). Energy use for heating has dropped by 30% for new housing in 2002 compared to those built in the 60s.
For multi-development it has unfortunately not been given the same effect; after a downturn in the '80s, energy use increased in 2003 and is evident at almost the same level as 40 years ago, STEM (2005b). This is despite the fact that today's standard, in terms of new construction of housing, is significantly better now than 30 years ago. Today's technology provides the ability to halve the energy use in new housing.

In my opinion, many real estate companies focus too much on low investment, instead of seeing the whole life-cycle cost.

According Flagan et al (1989) LCC analysis can be used to:

- Evaluate two or more investment options
- Be a basis to predict future costs
- Be a governing instrument to ensure that a product is used effectively to achieve the overthrow possible return
- Be the basis for budgeting and planning of future funding.

- Used to produce the total cost of ownership instead of the initial capital cost.

There are programs to make calculations of LCC and LCP but basically it is a net present value calculation with all operating and maintenance costs, acquisition costs and media costs included.
The difference is that in the LCP calculation includes revenue to calculate the life cycle profit.
Therefore, LCP can be a good tool for the participants to choose between two alternatives to the construction of houses.

The different types of installation

As I mentioned earlier, there are an infinite number of different systems depending on the building type. Below is an example of what they can be. In the most complex buildings, almost all of these systems are used, while in other less complex buildings, only a few are used.

- Tap water
- Water system
- Process system
- Steam system
- Compressed air system
- Vacuum system
- Gas
- Oil and fuel system
- Waste water system
- Process waste water systems
- Rainwater system
- Cooling system
- Heating systems
- Air treatment system
- Electricity system
- Telecommunications
- Elevators etc
- Control system

Residential buildings have:

- Heating systems
- Sanitary system (sewage and water)
- Electrical system
- Tele communications
- Ventilation, most commonly in the form of extraction system or natural draught
- Computer
- Control system
- Tele

Commercial buildings can also have:

- Cooling
- Sprinklers
- Ventilation systems with FTX

In the following sections, I will talk about parts of the installations that are present in a building

Water and sanitation systems

Tap water

Treated and purified water is used for the whole water installation in a building regardless of whether it is in the toilet or drinking water. In Sweden, we have plenty of drinking water but the cost of cleaning and treating the water is rising. The question is why should we have drinking water in the toilet?

Should we not dissociate the systems so that purified and treated water is used only for drinking and cooking?

The water conduit in Sweden consists of different types of materials. In the ground the materials are plastic, nodular cast iron, galvanic steel pipe, or copper pipe.

Indoors it is copper and plastic pipes which are mainly used.

It has begun to be questioned whether or not copper shall be used in the tap water, because the copper is not environmentally sound.

In order to receive appropriation for sewage sludge, there is a limit on how much copper it may contain

Stockholm, has problems in meeting these limits, as a result, they have started to look for alternatives to copper pipes. It is from copper pipes much of the copper in the sewage sludge arises.

Legionella
A problem in the tap water is the presence of Legionella bacteria.
Legionella is the name of a bacterial family that causes two different kinds of diseases, legionnaire's disease, a form of pneumonia, and Pontiac fever, whose symptoms are flu-like.

Legionella acquired its name after a July, 1976 outbreak among people attending a convention of the American Legion in Philadelphia. The mystery disease caused 221 people to become sick, causing 34 deaths. In that bicentennial year, a pandemic among U.S. war veterans was widely publicized and produced a national panic. On January 18, 1977 the causative agent was identified as a previously unknown bacterium, subsequently named Legionella.

Since then, at least 50 species of Legionella have been identified.

Legionella bacteria occur naturally in small quantities in rivers, lakes, and soil. The bacteria are dormant, and do not multiply at temperatures below about 20 ° C. The bacterium multiplies between about 20 ° C and 45 ° C, especially between 35 ° C - 40 ° C. The bacterium dies at higher temperatures.

It has been shown that, even at higher temperatures, the bacteria can survive if it is encapsulated in the tube wall in a bacterial bed. When the flakes of bacterial bed detach, the bacteria are released in to the water.

Legionella bacteria are so small that they can be transmitted in the water mist (aerosol). Fog occurs everywhere where water jets are destroyed, for example, when you shower, in evaporative cooling, in the whirlpool and more.
To fall sick, it is necessary that the bacteria enter down in the lungs. It is not dangerous to drink the water.

Examples of water installations in residential buildings where the Legionella bacteria can grow are:

- The back boiler in which not the full volume of water can be heated to temperatures above 50 °C, such as back boiler using heating elements that does not warm the water in the bottom.
- In back boiler where deposits (rust, dirt, etc.) are lying at the bottom, and back boiler is not possible to clean.
- In the pipes where the water is stagnent, such as branch feed pipes, which are rarely used.

How to avoid legionella.

- Make sure that the temperature is at least 50°C at the water outlet (shower, kitchen mixer, etc.)
- Make sure the hot water circulation is 50°C in the return to the heat exchanger or furnace.
- If you have a back boiler, let the water be over 60°C in the whole back boiler.
- Remove any blank casings. Be careful that no water is standing still in any part of the system.
- Towel-drying, under floor heating, etc. should not be linked to the hot water circulation system.

Within Akelius we hade a recent case in Luleå where an entire neighbourhood,of about 480 apartments -Hägern block- were affected by the legionella bacteria.

The discovery was made when a man, who was a tenant in the Hägern Block, died in the hospital and it turned out that he had legionella bacteria.

The immediate actions we took were to install a chlorine dioxide unit which dosed chlorine dioxide into the water.
The chemical kills the bacteria within a fraction of a second.
The big problem we have is that the hot water circulation has poor dimensioning; this causes the temperature of the hot water to remain too low, and the legionella bacteria reproduce.

It turned out that the system, which is built in 1973, had valves in some apartments which were closed or just barely noticeably open.
We have installed new valves and water temperature monitoring on each circulation main pipe.

We have also removed all pipes that are not in use, to avoid stagnent water

Still, after six months, we are not rid of the bacteria. The next step is to further increase the circulation flow.

So far, the cost is approximately 700,000 SEK and we still have problems.
It shows that there is a reason for taking the problems of legionella seriously, especially when you build new houses or renovate old houses.

Pipes
When you dimension the tap water system, you must take into account the risk of excessively high pressure, which might occur if you have incorrect pipe dimension.
Surge can cause a lot of damage, the pipe joints can become loose because of the force that occurs at that kind of pressure.

Water damage
Water damage is a major cost for housing.
In order to prevent it, there is a lot of advice and instructions that should be followed in the construction and renovation.
One example is the project "Vaska," which is used in Sweden.
In this project examples are given on how to minimize the risks, and how to prevent water damage.

Sewerage system

In Sweden, plastic and cast iron has been the most prevalent material used for pipes.

Plastic tubes which were manufactured in the 70’s have major problems, as they become brittle and can break very easily.

Sewage systems have had different styles over the years.

During the 80's, the low-level-flush wc was introduced, to accommodate the smaller quantity of water in the pipes there were siphon conduits off each main pipe, these collected a larger amount of water before it ran out in the municipal network.

The system is left but is rarely used.

After conducting a number of projects with low-level-flush systems, where we had to increase the amount of water during flushing; I would like to warn against installing a low-level flush wc in an old sewage system. There will be problems getting the run-off and with the self-cleansing if the flow becomes too low.

Perhaps low-level-flush systems could have a renaissance?

Another thing to consider in the construction, and especially in the reconstruction, is the noise level. When replacing the old pipes and you drill through the beams down to the apartment below, you must ensure that the noise does not disturb the tenant every time you flush.

Cast iron has excellent noise reduction properties, but there are also thick-walled plastic tubes that have decent properties.

Ventilation systems

A building has a ventilation system. Whether it is the form of natural draught or using fans, there is always an air change.

One of the differences between natural and fan ventilation is that the natural air change is uncontrolled and affected by the thermal forces that vary with the difference in the outdoor temperature and indoor temperature.

Natural draught System

Earlier the ventilation systems consisted of masonry ducts, later sheet metal ducts. The ducts ended in chimneystacks on the roof. Each room often had a solid duct.
Supply air was introduced through outdoor air intake in the wall or window shutter.
The technology is based on that it is colder outdoors; the colder it is outdoors, the more ventilation. It is physics, warm air rises up.
The drawback of the system is that you rarely need more ventilation in the winter, but rather more ventilation in the summer.
Furthermore, it works only if there is a height difference.

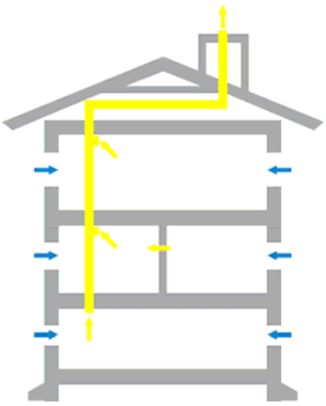


Illustration of a natural draught system

Extract air system

When we realized the shortcomings of natural draught, we started to install fans that act as exhaust fans. The outdoor air intake was often in the window frame.
Extract air is still used frequently in the housing sector.
The advantage compared with natural draught is that you can choose how much ventilation you want.
It is also possible to install equipment that reduces the airflow when the outdoor temperature is falling.
There are two major disadvantages, a cold downdraught is perceived, where the outdoor air intake is situated.
No heat exchanger, if you do not install an air heat pump.
The advantage is that it is relatively inexpensive to install.
However, to make an LCC calculation under previous reasoning, it is not certain it will be so cheap if you look at the total cost.

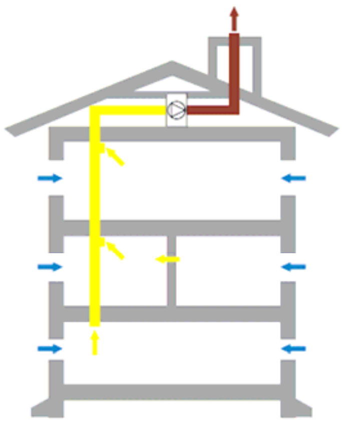


Illustration of the extract air system

Mechanical ventilation system

Supply and extract air systems were already installed in the 50's. In the beginning it was installed without heat exchanger, but in line with increase in energy costs, it began too be a good business to install heat exchangers. The most effective heat exchanger is the rotary heat exchanger.
80 % of energy from the air can be recovered. If you install two rotary exchangers, one after each other, a recovery of almost 90% can be achieved.
The rotating exchanger heated by the hot air and delivered to the cold outdoor air. The risk is that, if the air contains pollutants such as the smell from frying food, it can be transferred to the supply air. You do not have this problem if you install a cross-flow heat exchanger.

In cross-flow heat exchangers, the extract air warms up the exchanger package. The supply air, which is cold, has now been warmed up by the heated exchange package.
The extract air and the supply air are never in contact with each other, which will eliminate odour transfer.
The recycling rate is however, worse than the rotary system, about 60%.

There is also a battery - battery exchanger where the heat from the air heats up the water in a water system, the heat is transported by a pump to a battery in which the supply air warms up.
The recycling rate is not as high in these systems, approximately 50% is fairly normal.

The advantage of the mechanical system with heat exchangers, called FTX in Sweden, is the low energy cost; this is as a result of the improved indoor climate, no cold draught and thus no cold floor.

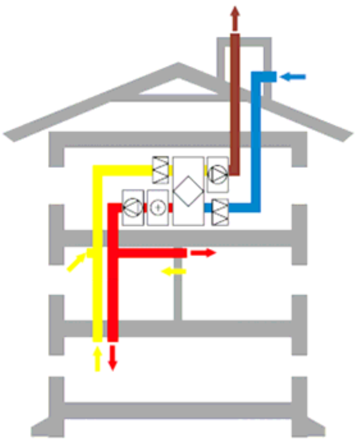


Illustration of a mechanical ventilation system with heat exchanger

Ventilation is often the subject of scrutiny, some believe that the problem with “sick houses” comes from poor ventilation.

I had some assignments involving cases of “sick house syndrome”, I discovered that the ventilation is rarely the cause. As an anecdote, I can describe how a building manager once increased the airflow significantly, when he received complaints of bad air from the tenants.
Without finding out the cause, he increased the amount of air. The first thing we did when we were engaged was, an air volume measurement, we found that the air volume was almost twice recommended.
When we asked the tenants about the symptoms, they complained about dry mucous membranes.
Furthermore, it was winter, and the relative humidity is very low then. We decreased the air volume and the problem disappeared.

Electrical system

Electricity systems in buildings usually only include low voltage.
However, there have been some decisions about making system solutions in a building.

Lighting

There has been a rapid development in recent times in the case of lighting fixtures. The new modern lighting fixtures have longer life and are more effective, such as high-frequency devices and T5 lighting fixtures.
It has shown that some new modern lighting fixtures do not last, and then you lose profits due to the high maintenance costs.

Future lighting fixtures will certainly consist of LED lights.

Lighting has a life cycle cost allocated according to the following:
Electricity 70%
Investment 10%
Operation and maintenance 20%

The lighting fixtures can be equipped with a presence sensor.

Control and Monitoring system

Control and monitoring system, has the task of managing, regulating and supervising the technical installations in buildings.
There are a lot of different systems on the market.

Previously, there were simple controlling systems that in principle everyone could handle. There were knobs on the unit where you choose which supply water temperature you wanted, depending on the ambient temperature.
These units still exist in many buildings.

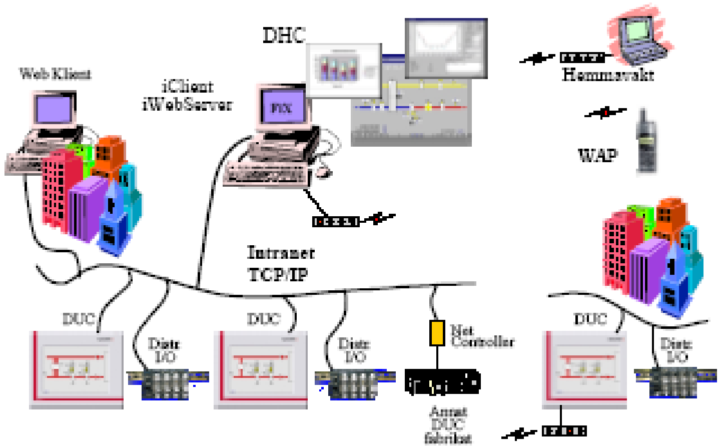
Over time the controlling systems have become more sophisticated.
Today, the units are computerized. With a computerized control system, you can control the heat, hot water, and ventilation equipment.
If there are more installations you want to steer, you just connect multiple computerized control units in a network.
When you have done that, you can control which installation you want from whichever unit you want.
If you have many different units in the building, or in the whole stock, it may be a good idea to have an overall system so you get better overview of the installations.

Many of the large manufacturers have used their own protocols for their computerized control systems, and the main control systems. This means that once they have installed their products, they are in fact the only one who is able to expand the system. Have you gotten into this situation, the cost of the deployment of the system will be high.
You can avoid it by choosing a system that has an open protocol. Then you can supplement the system with other manufacturers or other contractors.

There are computerized units that have direct Internet access, which allows you to surf in to the unit from wherever you are. The units with internet access are suitable in individual buildings, but can be problematic if you have several buildings and you need to surf in to every unit to see the status.

It is possible to build a very complex system at any time; however, I think it is important to have the operational aspect in mind when you decide which system you are going to install. Do the operating engineers or janitors have the capacity to manage the system? That is the question you always have to ask yourself.

There is a theory that when you replace your old devices with a modern computerized control system, you can save 5% of the heat energy.
This theory may be true in some cases, but that is when the staff constantly monitors, and has the skills and knowledge about the system, and everything goes according to the preset operating parameters.



The principle of a computerized control system

Heating system

A heating system can be designed in a variety of ways.
Direct electric heating, warm air central heating, under-floor heating, hot water radiators, and ceiling heating are the most prevalent.

As the water system is the most common, I will concentrate on them.

The system is built with a heat source; with district heating it is a heat exchanger, pumps, pipes, and radiators.

The heating system can have different water temperatures, earlier it was common with 80°C on the flow temperature, and 60°C on the water return temperature.
There came a code of practice in Sweden, SBN 80, which contained a requirement that heating systems should be designed for 55 ° C - 45 ° C.
That means that both radiators and heating pipes had to be dimensioned to double size, compared with a 80 - 60°C system.
The old heating system is often so excessive, that it is possible to introduce cryogenics, 55-45 ° C.
The benefit of a low temperature system is especially if you intend on installing a heat pump, but it is also an advantage when you are connected to a district heating system and where the supplier has a system of penalties for too high return temperature to the district.

The disadvantage of heat pumps is that they can only deliver maximum 55°C in the supply water temperature, if you have 80-60°C, you need to heat with an alternative heat source, such as electrical heating element.
Today, there are heat pumps with higher capacity in temperatures, but the efficiency is lower, because it costs more electricity to produce heat.

Heat Sources

It is difficult, if not impossible, to say that a particular source of heat is right in all buildings.

For example, in Luleå in Sweden, district heating is so cheap that it is hardly worthwhile to install anything else.
However, there may be places where the district heating is so expensive that, in a cost / benefit analysis, it could prove that a heat pump is more profitable.

Below are some examples of heat sources.
There are of course more, but I have chosen to highlight the most prevalent.

District heating

District heating is a common heat source in Sweden.

The advantage is the availability and simplicity.
It is cheap to install if you have the building located in the vicinity of district heating pipes.
Apart from the environmental viewpoint, there are also major advantages.
Instead of everyone having their own units with varying efficiency of gas treatment, it is easier to do it in thermal plants that serve several buildings.
The disadvantage is the monopoly that is created when there is only one supplier you can purchase from.
There is a risk that prices soars, and that you cannot do much about it.

Bio fuel Boilers

Bio fuels are renewable fuels that are produced by living organisms (biomass).

If you have an old oil boiler, it is possible to convert it to a pellets, or wood chip boiler.

Bio fuel can be an alternative to district heating and heat pumps, if you look at the investment cost.
The disadvantage is the higher operating and maintenance costs.
Often, it is the feeding of fuel to the burner that is the big problem.
It is necessary to have large storage rooms to store pellets or the wood chips.
Operating costs can be high if you have a large plant, because they require more supervision.

Heat pump

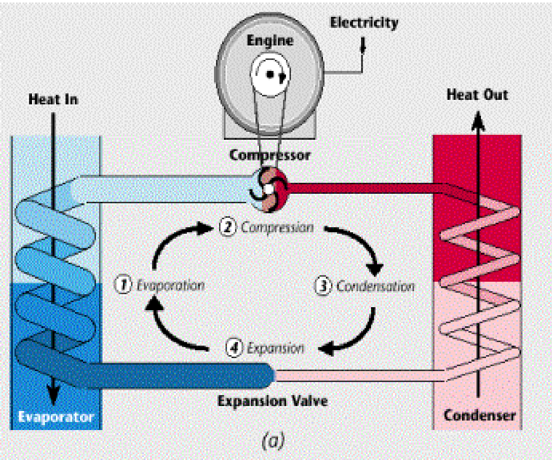
A heat pump is similar to a refrigerator - but in reverse principle! Cooling works through heating using electricity, but it is uses three times less power, compared with electric heating. How does it work?

A heat pump consists of four components: evaporator, condenser, expansion valve (flow restrictor valve which lowers the pressure), and the compressor (which increases the pressure). These four parts are connected by a closed pipe system.
In this piping there is circulating a substance (often referred to as refrigerant), which in some parts of the circuit is in liquid form and in other parts of the gas.

A liquid boiling point varies with the pressure. Water boils for example at 100°C at normal pressure. If you reduce the pressure of the water to half, the boiling point would be at + 80°C and if you raise the pressure to double, it will boil at 120°C.
It is these physical characteristic that makes use of refrigerants. Their boiling point is however, as low as about -40°C at atmospheric pressure.

In some of the heat pumps, the refrigerant has a low pressure and can take up "cold" heat to the boil, and vaporize in the evaporator. After the compressor, the refrigerant has a high pressure, and this condensed refrigerant is transferred to liquid, and that gives off its heat.

The efficiency of a heat pump is measured by a heat factor, which is how many times more heat energy a heat pump supplies compared to how much electricity it consumes.



The principle of a heat pump

There are different types of heat pumps.
For example, geothermal heat, ground source heat, and air source heat.
All the types have the same function, what differentiates them is how the evaporator is used.

Geothermal heat pump
With the geothermal heat you take the heat from the bedrock.
The geothermal heat pump is an expensive investment. There are often deficiencies in the formation of the borehole which can be too shallow.
If the borehole is too shallow compared with the heat consumption, it may cool down so much that after a few years, it may even freeze up.

Ground source heat pump
The ground source heat pump is taken the heat from the ground.
You only have to dig down a hose with a liquid that circulates in it. It takes the heat from the soil.
The hose is maintained at about one meter depth. If it is too deep, there will be too little heat, and if it is too shallow, there will be frost in the ground until the summer.

Extract air source heat pump
The air source heat pump takes the heat from the extracted air.
It is a fairly cheap investment to install, but the impact may be limited as it is dependent upon the amount of air you have access to.

Outdoor air source heat pump
The outdoor air source heat pump takes the heat from the outdoor air. Of course, it is depends on the outdoor air temperature just how much energy you can get.
Many outdoor air source heat pumps are able to make use of the outdoor temperatures down to -20°C, but then the efficiency is reduced significantly.

The effectiveness of a heat pump will vary depending on the type of heat pump, but is approximately 1:4, if you enter 1 kW of electricity you get 4 kW heat.

Solar Energy

The solar radiation can be used to generate both heat and electricity, which is done with minimal environmental impact

Solar panels for heat and hot water are interesting, where heating needs are consistent with available solar radiation.
All buildings and facilities with hot water needs during the summer can be good applications.

Solar energy is particularly interesting in the cases combined with bio fuels. Then received close to 100% renewable heat supply and solar can stand for heat supply in the summer when the bio fuel plant has a lower efficiency.

Solar radiation is instantaneous up to 1000 W / m² and contains more than 1 000 kWh of energy per sqm, per year in Sweden.

Solar panels generate instantaneously up to 700 W heat per sqm, and from 200 to 700 kWh of heat per sqm per year, depending on the type of system.

Solar cells generates instantaneously up to 150 W Electrical power per sqm, and from 50 to 150 kWh of electricity per sqm per year, depending on the type of system.

Personally, I believe in solar energy as a future energy source. Earlier it was expensive too install, but the prices are falling and they are more effective.
It would be interesting to do a further analysis as to whether or not there is an alternative for an apartment building.

Wind Power

According to a government decision, the objective is that Sweden should have increased the proportion of wind power from the current 0.7 to 10 TWh in 2015
With the help of new taxes and subsidies, Swedish wind power is now a competitive alternative, compared with other energy sources.
With subsidies and tax breaks, electricity from wind costs 20-23 cents / kWh to produce; a cost that can be compared with electricity from hydropower, which costs 23-36 cents / kWh.

The question I ask myself is whether or not it makes sense that we can, with the help of subsidies, create conditions for wind power.
The subsidy paid to the building of wind power must be taken from somewhere else, in this case from the taxpayer.
If you include that in the total cost I think it is doubtful that it can be profitable.

If you have in mind that, it is only about 25% of the time it blows enough for the wind power to operate properly. This means that either it must be possible to store wind energy, or there must be other production to meet electricity demands when it does not blow.

A prerequisite for investment in wind energy for the companies is the electricity system.
The system is subsidizing alternative energy and ensuring the profitability of wind projects. The subsidies are valid until 2016, and the limit is set at 17 terawatt hours.

Electricity networks in Sweden are not dimensioned for expansion of wind power.
This applies especially to backbone networks between the north and south which the Swedish state power is responsible for.
According to former defence Minister (Mikael Odenberg in the alliance government and now Director General of the Swedish grid networks), there are just enough for an expansion by 10 terawatt hours.
If wind power in northern Sweden is continues to expand without enough backbone structure, we will have to cut down on hydroelectric power.
By doing this, we will have managed to build up an energy source that is fundamentally unprofitable without subsidies, and reduce the more profitable hydroelectric power.

In any case, because of the subsidies, wind power is an interesting investment from the property owner’s point of view.