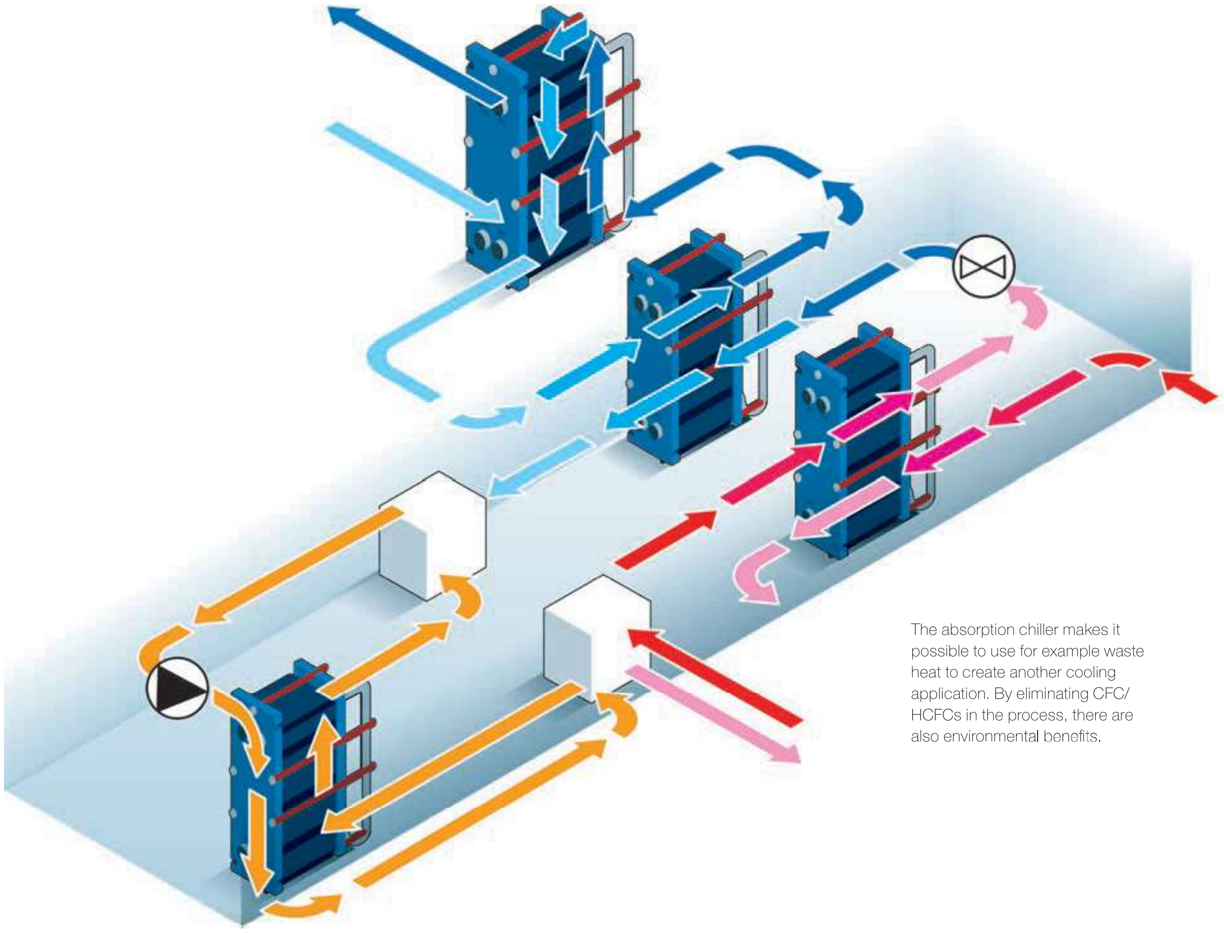
Absorption chiller

If district heat or waste heat is available, for example from waste disposal, there is another possibility for comfort cooling with an absorption chiller. This is an example of the kind of system optimization that Alfa Laval excels in.

We have the knowledge and just the right equipment for providing solutions with both economical and environmental benefits.

In this application the CFC/HCFCs influencing the ozone are replaced with for example water and lithium bromide, both environment-friendly. In the evaporator the refrigerant (water) takes up heat/energy from the connected system, thus cooling the air conditioning circuit in a heat exchanger. The refrigerant enters the absorber as low-pressure vapor, where the liquid solvent (lithium bromide) absorbs it. The pump increases the pressure and the mixture continues to the interchanger where it is preheated in for example a plate heat exchanger. Using the district heat, the refrigerant is boiled off from the solvent in the regenerator. The high-pressure vapor is sent to the condenser, where heat is emitted during the refrigerant's condensation.



The absorption chiller makes it possible to use for example waste heat to create another cooling application. By eliminating CFC/HCFCs in the process, there are also environmental benefits.

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100004902-1-EN 2111

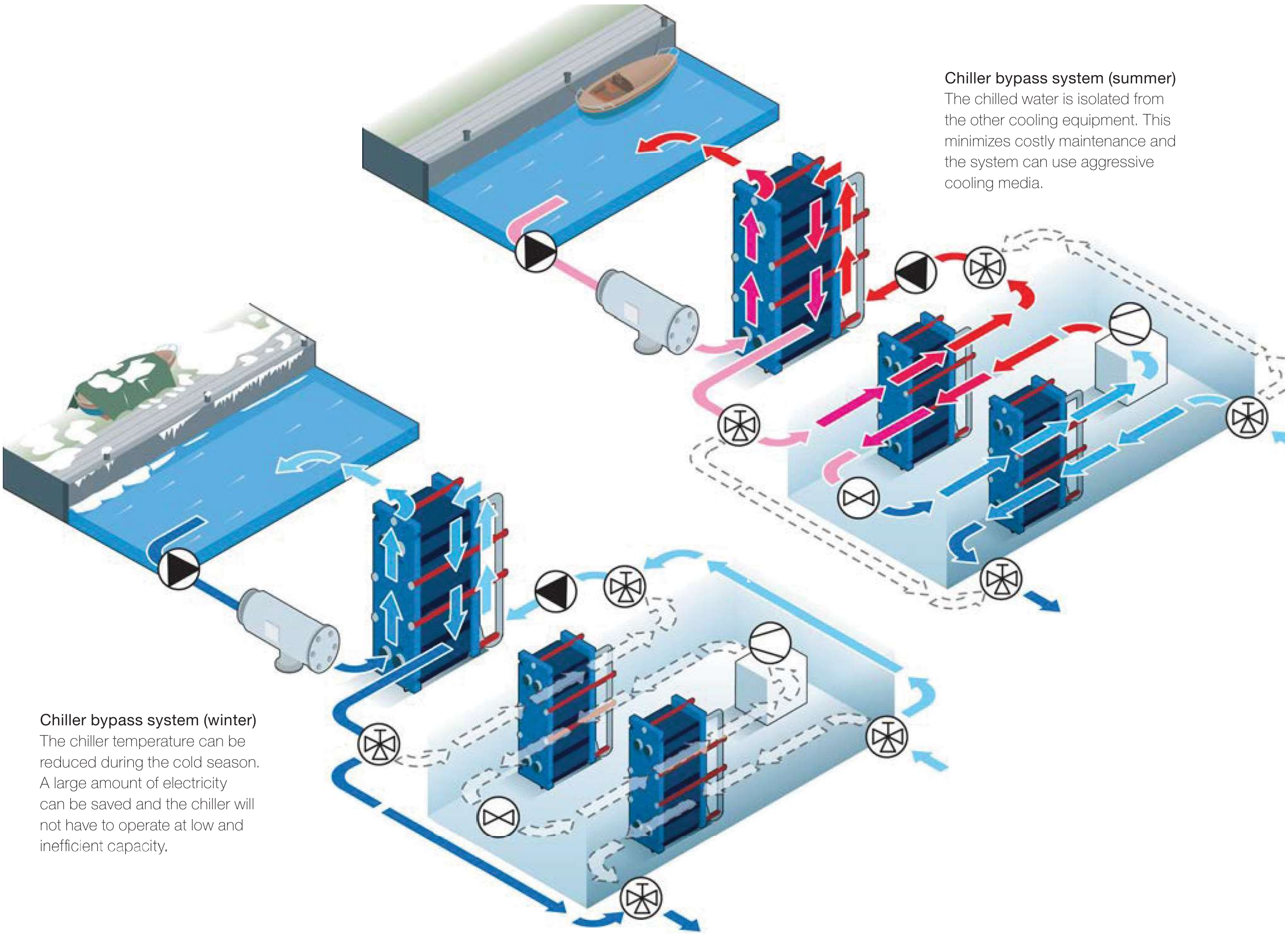
Chiller bypass

Traditionally the chiller in an air conditioning system runs continuously during the entire cooling season, even when full capacity is not required.

Previously, the only alternative to constant chiller operation has been a chiller bypass system using a strainer. This strainer removes impurities, but at the same time it requires costly maintenance, chlorination and other chemical treatment.

By installing a plate heat exchanger – and sometimes a filter to protect it – in the chiller bypass system, corrosion, scaling and constant maintenance can be virtually eliminated. Another advantage is that this system can use any type of cooling, such as a cooling tower or free cooling with river or well water, even seawater or brackish water, without ruining sensitive equipment like air conditioners.

As soon as the bulb drops below the required condenser temperature (min. 1°C/1.8°F), the heat exchanger makes it possible to reduce the chiller temperature. This means that a large amount of electricity can be saved during the cold season. It also means that the chiller will not have to operate at a low and inefficient capacity, and that chiller maintenance can be efficiently scheduled during this period. Total investment costs are generally paid back in six months to three years, depending on local conditions.



Chiller bypass system (summer)
The chilled water is isolated from the other cooling equipment. This minimizes costly maintenance and the system can use aggressive cooling media.

Chiller bypass system (winter)
The chiller temperature can be reduced during the cold season. A large amount of electricity can be saved and the chiller will not have to operate at low and inefficient capacity.

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100004904-1-EN 2111

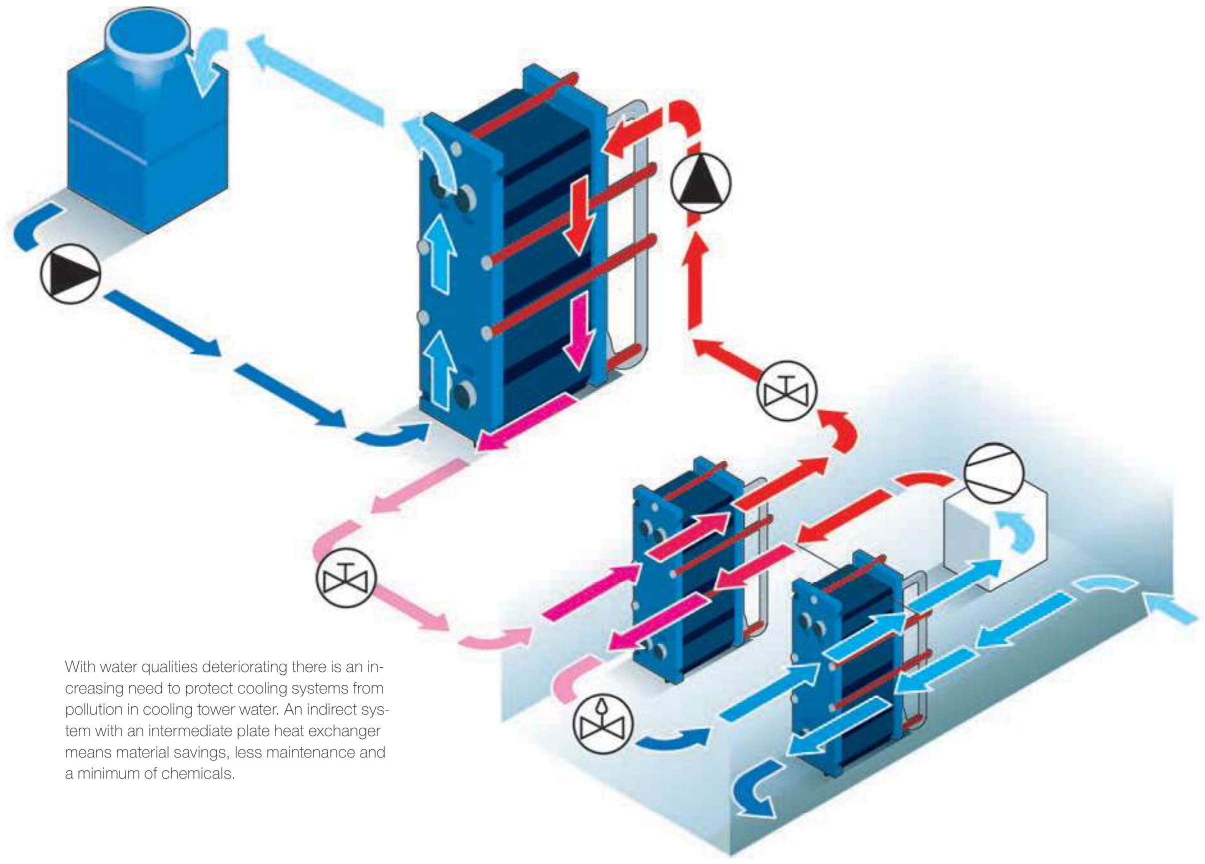
Cooling tower

Today water qualities are deteriorating because of different kinds of pollution. This increases the risk of chiller shutdowns due to operation problems of the condenser.

The condenser is subject to attacks from either chlorides that will cause corrosion or impurities or biological activities in the water that will cause fouling. As the expectations of trouble-free cooling operations have increased, it has become more and more interesting to look at alternative solutions where these problems can be avoided.

One solution is an indirect system using a heat exchanger in combination with an open cooling tower. The advantages of this are:

- Low system cost: Cost calculations show that the payback period of the heat exchanger is very short.
- Material savings in the condenser: Less expensive materials can be used.
- With an intermediate heat exchanger, chillers as well as cooling towers can be run at an optimal temperature.
- An intermediate heat exchanger means that the use of water treatment chemicals, for example chromates used for the cooling tower water, can be minimized.
- Less maintenance of the condenser.



With water qualities deteriorating there is an increasing need to protect cooling systems from pollution in cooling tower water. An indirect system with an intermediate plate heat exchanger means material savings, less maintenance and a minimum of chemicals.

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100004908-1-EN 2111

Free cooling

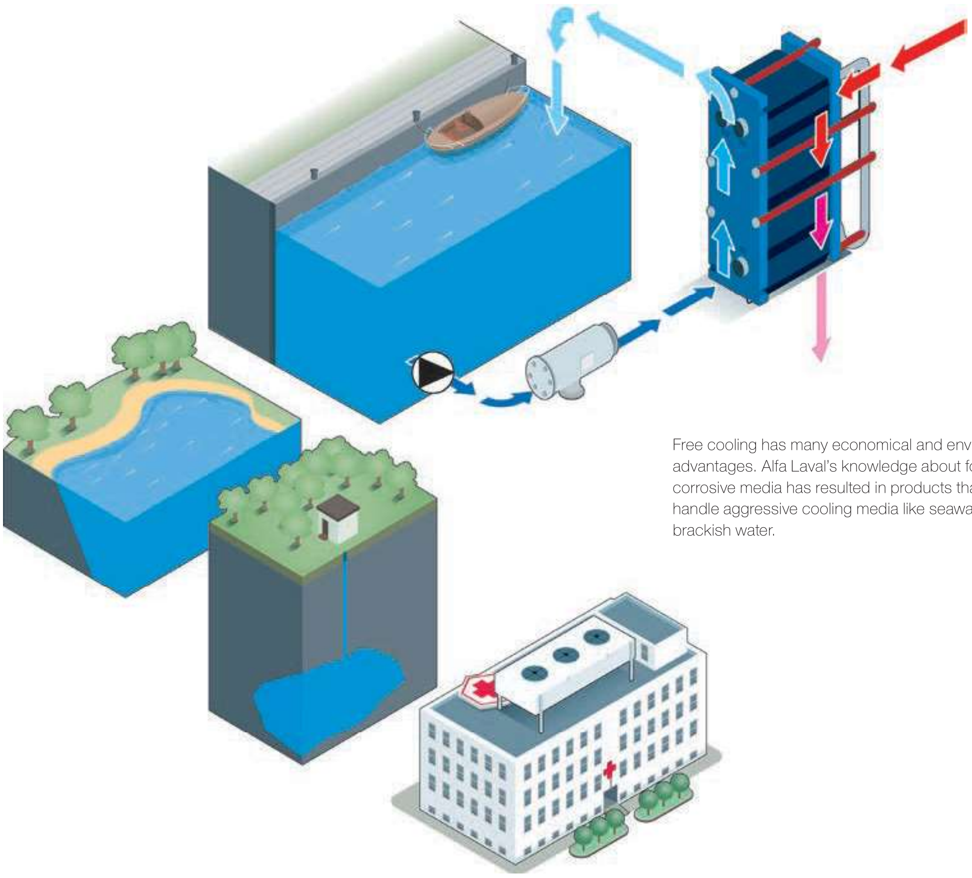
Free cooling combines an environment-friendly alternative for producing cold with economical benefits. Cooling applications relying on free cooling have been installed with good results in many countries around the world.

When utilizing free cooling as a cooling source in an application, the use of ecologically harmful refrigerants can be reduced. Free cooling is also a way to cut down on electricity costs – in some cases the reduction might exceed 75 percent, resulting in great savings. Reduction in electricity consumption also has positive environmental effects, as electricity production often involves air pollution.

Free cooling is used mainly for air conditioning and process cooling. It can cover the cooling requirements during the period when the free cooling source has lower temperature than the cold water, for example during winter. In spring and autumn a combination of free cooling and chiller-produced cold is used. In the summertime the chiller supplies the total cooling requirement. Suitable free cooling sources are water from for example rivers, lakes, (deep) oceans or ground water, ice and snow storage, or air.

Products for free cooling

Alfa Laval's continuous research and development strategy means we are able to supply products for any cooling application, regardless of cooling media and cooling source. This makes it possible to utilize aggressive cooling media such as sea-water, brackish water, or water from rivers and wells.



Free cooling has many economical and environmental advantages. Alfa Laval's knowledge about for example corrosive media has resulted in products that can handle aggressive cooling media like seawater and brackish water.

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100004912-1-EN 2111

Gensets and cogeneration

The full benefits of energy efficiency cogeneration or combined heat and power application is a very effective and efficient form of power generation, allowing total energy utilization to reach 90%.

Combined heat and power applications from Alfa Laval

This efficiency doesn't just happen by itself – it's the know-how behind it that produces such great results.

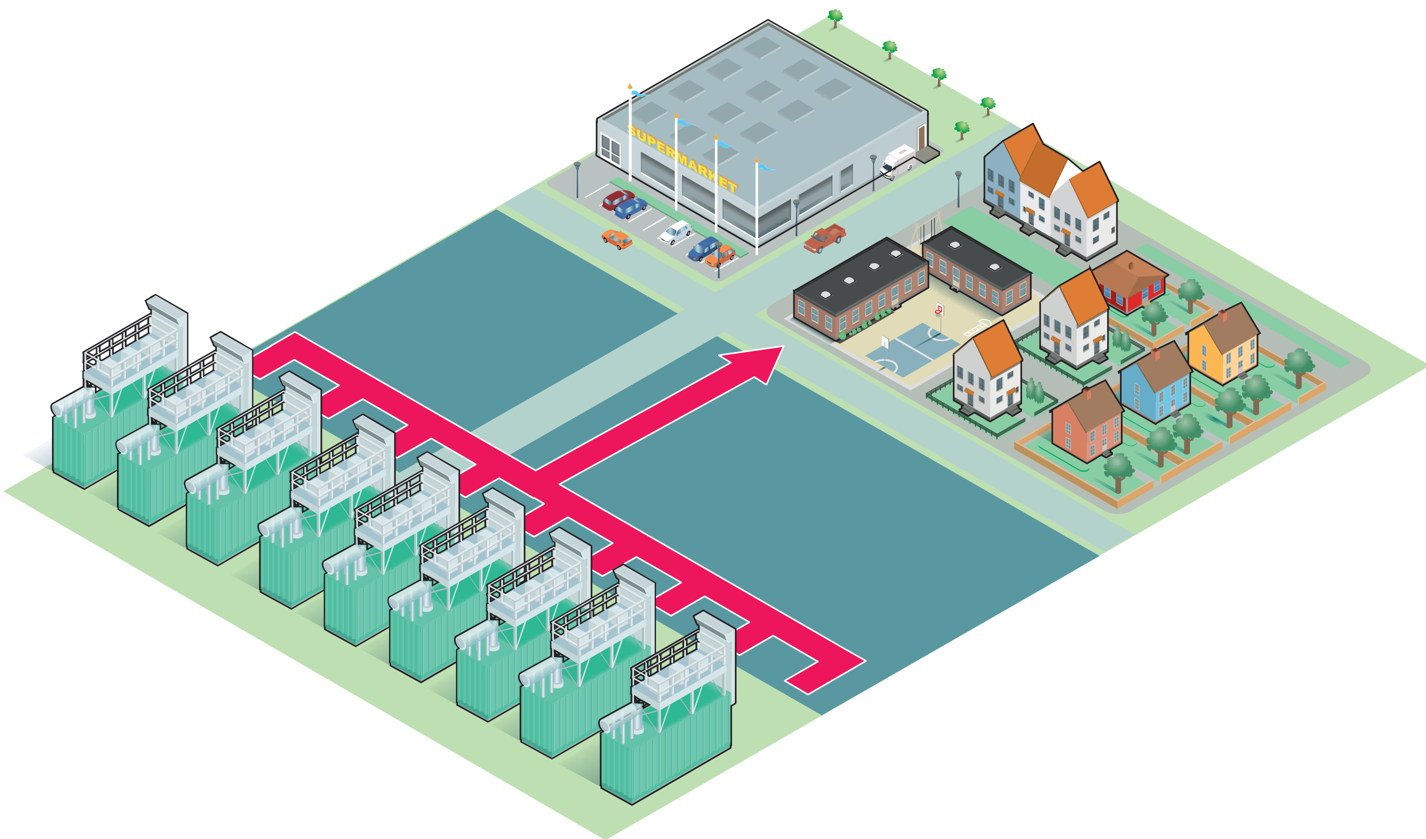
Alfa Laval offers a complete range of cooling solutions for both gensets and combined heat and power systems.

With an extensive focus on R&D, air heat exchangers (AHEs), gasketed plate heat exchangers (GPHEs) and brazed plate heat exchangers (BPHEs) have been developed to ensure lower emissions and substantial cost savings year after year due to their cost-effective, highly engineered designs.

Alfa Laval offers more than just products, we offer a partnership based on our long experience, resources, and engineering proficiency.

Having delivered optimal heat transfer solutions for more than a century,

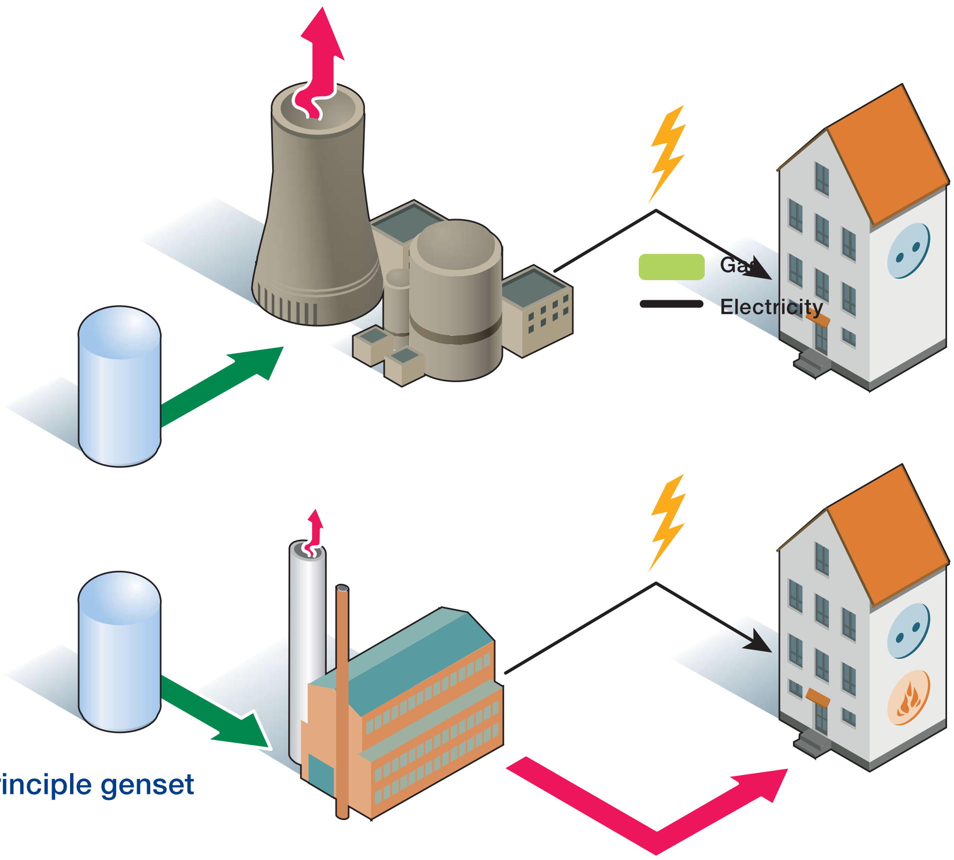
Alfa Laval meets a wide range of needs and offers unparalleled expertise – ensuring future-proof solutions that can be relied on time and time again.



Gensets

A generating set or genset is a system that generates electricity. The purpose of a genset is to provide back-up or redundancy electricity when the primary systems go offline. Thus, if the standard supply of electricity fails, then the genset will still fulfill the need and a blackout is avoided. Gensets are often used for critical social functions, such as industries, agriculture, water treatment plants, heating plants/district heating systems, shopping centres and banks.

The genset system consists of an engine, fueled often by diesel or natural gas, which drives a generator. The generator then creates the electricity to be used by the site. When the engine is running it becomes heated and needs to be cooled. A typical engine will have two circuits, one high temperature (HT) and one low temperature (LT) circuit, which need to be cooled to ensure the continued performance of the engine and, in turn, the genset. Alfa Laval's wide portfolio of air heat exchangers, AHE, can offer both combined and single circuit configurations in one compact unit, making the installation more compact.



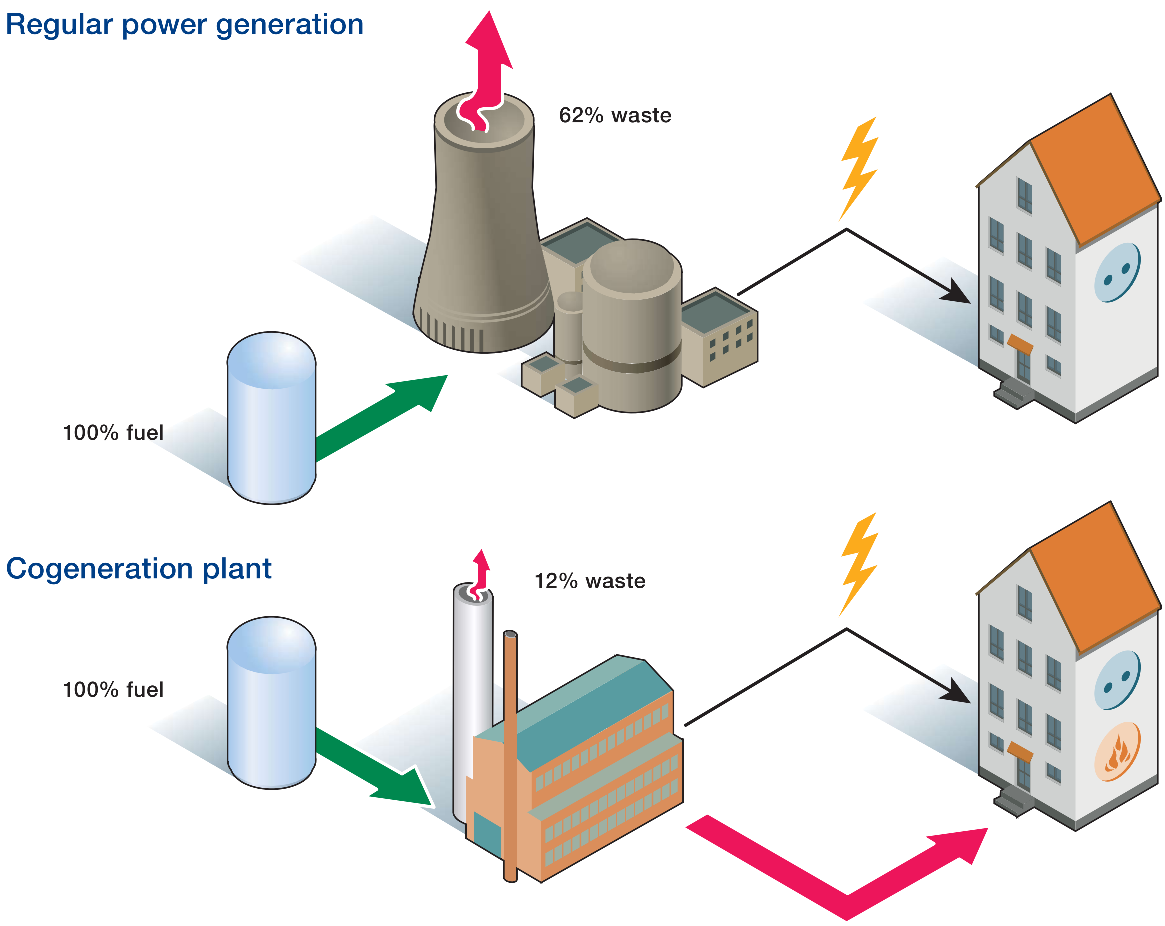
Working principle genset

Combined heat and power – natural gas/diesel

Combined heat and power systems, CHP, utilize the heat created when an engine is running. The heat can be recovered and used via Alfa Laval plate heat exchangers, PHE's. This type of system is used either as a primary source of energy or as a secondary source for critical social functions, such as hospitals, schools, hotels and retirement homes. The benefit of using it as a primary source is that the installation is self-sufficient and full control of uptime and downtime is possible. When used as a secondary source of energy the benefits are the redundancy of the central energy grid and the security it provides against power shortages.

CHP's offer many benefits:

- More efficient utilization of input energy.
- Waste heat is a positive byproduct.
- Possible to sell surplus electricity and heat back to the grid.
- Low emissions and environmentally friendly (especially with natural gas).
- Efficiencies in biogas production help cogeneration development from an agricultural perspective.
- Possibility of government subsidies.
- Payback time 3-5 years, depending on system set-up

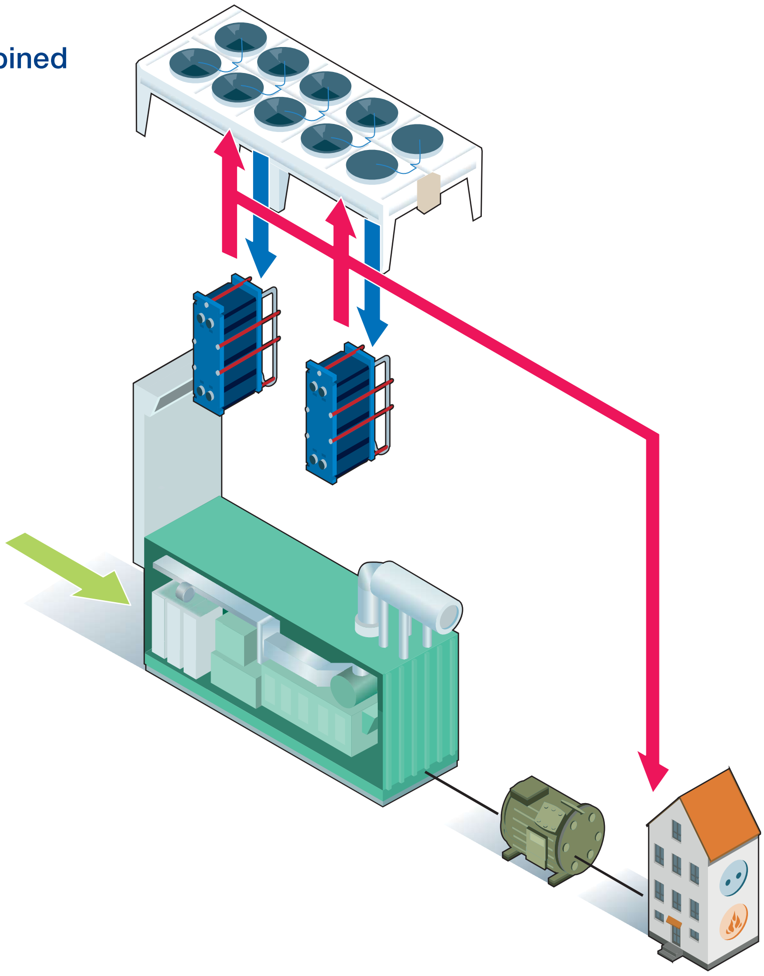


Working principle

The concept of CHP is built on “simultaneous generation of two useful forms of energy, electricity and heat, from the same plant using one single primary energy source”.

An engine generates heat from the lube oil, low temperature circuit and from the jacket water, high temperature circuit. If these circuits are connected to Alfa Laval plate heat exchangers, PHE’s, the heat can be recovered and used. This is done by having the secondary sides connected to separate water circuits from which you can extract the heat for any purpose, typically tap water or an indoor heating system. When the engine is producing more heat than is needed, the heat stored in the secondary circuits needs to be dissipated. This is preferably handled by an Alfa Laval air heat exchanger, AHE, also called a dry cooler.

Working principle combined heat and power system

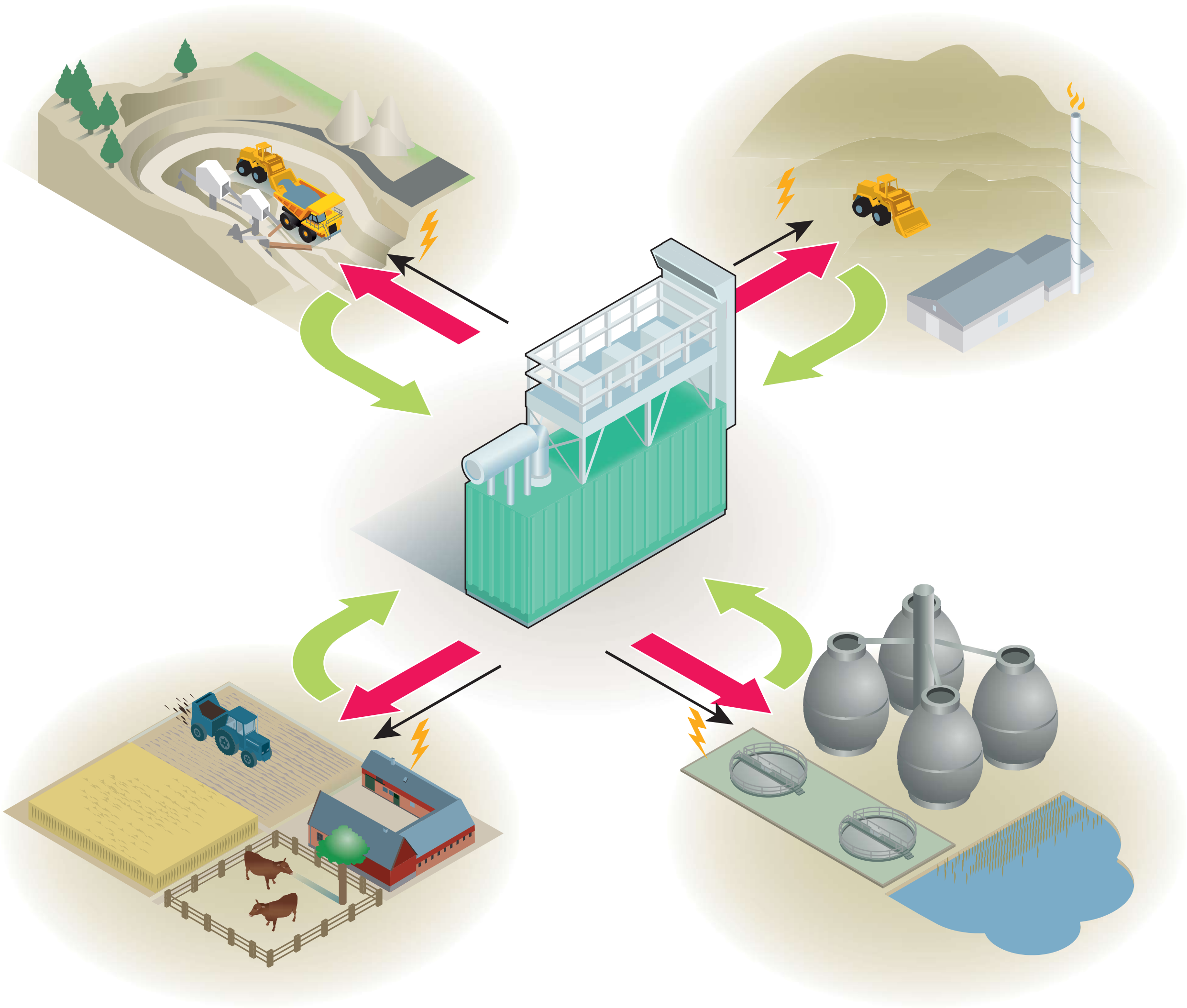


Combined heat and power – biogas

For areas or sites that produce their own biowaste, there is a profitable opportunity to convert this into biogas that can be used to fuel a combined heat and power system. Thus, sites such as farms, wastewater treatment plants (wwtp), landfill waste and mines, can be self-sufficient in terms of energy and create their own independent, sustainable energy cycle, where all energy consumed is also created via their own waste.

Since it is only the engine fuel that is different, the working principle of the biogas CHP is the same as the CHP system fueled by natural gas or diesel, as described in an earlier section.

Alfa Laval's extensive portfolio includes PHE's suitable for heat recovery in the LT and HT circuits, and AHE's for dissipating excessive heat.

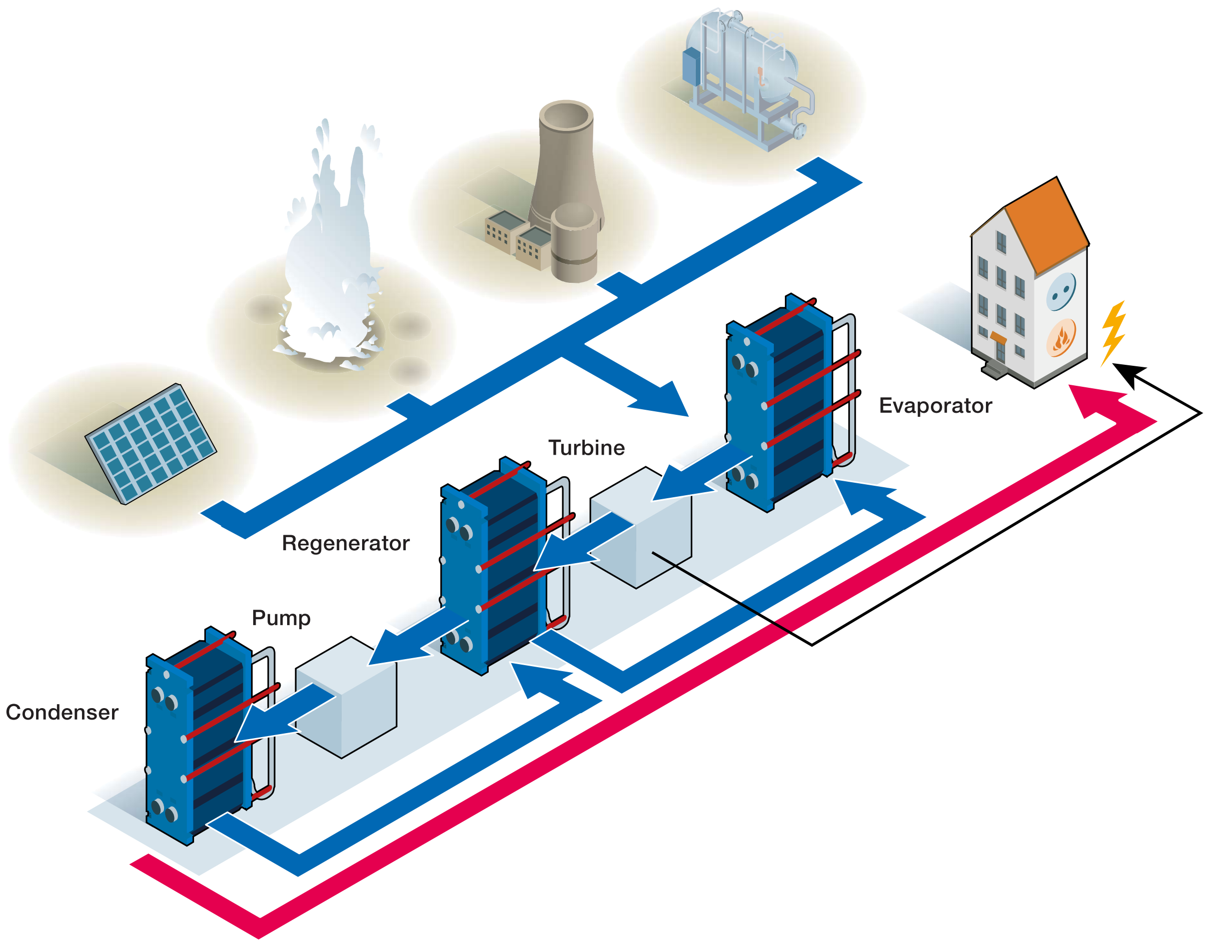


Organic Rankine Cycle (ORC)

The Organic Rankine Cycle (ORC) is named for its use of an organic, high molecular mass fluid with a liquid-vapor phase change, or boiling point, occurring at a lower temperature than the water-steam phase change. The fluid allows Rankine cycle heat recovery from lower temperature sources such as biomass combustion, industrial waste heat, geothermal heat, solar ponds, etc. The low-temperature heat is converted into useful work, that can itself be converted into electricity.

The working principle of the organic Rankine cycle is that the working fluid is pumped to a boiler where it is evaporated, passes through a turbine and is finally re-condensed. The system is fuelled by adding energy into the evaporator at high temperatures and useful energy is extracted from the turbine/ expander, as electricity, and from the condenser, as hot water/ heat. To improve the efficiency of the system a regenerator can be added into the cycle.

Typical usage areas for an ORC system are different types of power sources, such as biomass power, geothermal plants, solar thermal power and waste heat to power systems.
All these types of system are considered renewable and environmentally sound.



APPLICATION KNOWLEDGE

Geothermal heating

Geothermic is the science that studies the earth's heat. The earth´s heat content (enthalpy) is 1031 Joule and the energy the earth sends out in the atmosphere is double that what we consume. Today we only use a small fraction (0,07%) of the available geothermal energy available. A great untapped resource is at our disposal.

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By using heat from geothermal water we have a cheap and environmentally friendly method for heat generation.

The ground is an inexhaustible source of heat and the seasonal variations in the soil temperature is reduced as depth increases.

At depths of 15 to 18 meters, the ground's temperature will remain absolutely constant year round at 9-12°C. As we go deeper, the temperature will not only remain constant, but will increase by an average of 3°C every 100 meters.

Geothermal heat is used in two major areas of application:

- Direct use of geothermal energy, involving geological anomalies or volcanic activity that provide a source of steam (which can be used to produce electricity) or hot water for heating buildings and tap water
- Low enthalpy geothermal energy, where the subsoil or ground water is used as a thermal reservoir in combination with heat pumps.

Especially in the low enthalpy geothermal energy, growth has been spurred by the availability of increasingly efficient heat pumps. With current technologies, using heat pumps is very safe and requires no additional energy from other sources (e.g. natural gas boilers) to cover consumption peaks or situations where performance is reduced.

Since the geothermal water often contains chemicals and solid particles aggressive to the plate it is important to select suitable plate materials for the main heat exchanger. Titanium or SMO are often used because of high content of calcium. Gasketed plate heat exchangers are often the preferred solution due to good serviceability, maximum heat transfer, high capacities and possibilities to increase or decrease the capacity.

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100004916-1-EN 2111

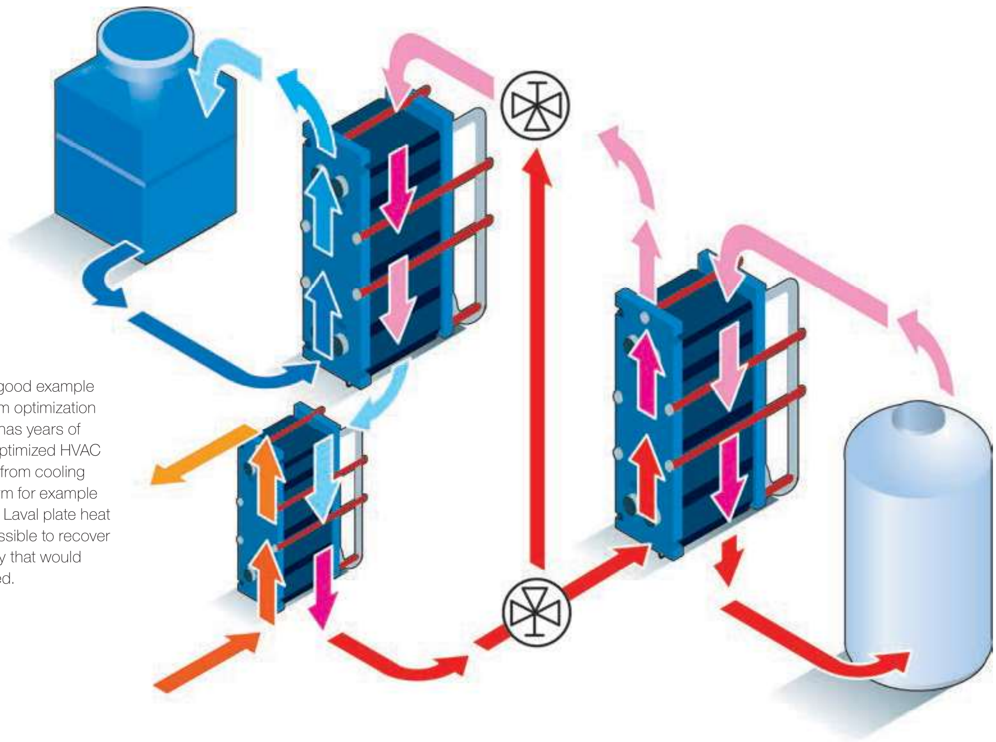
Heat recovery

In an optimized HVAC system, cooling and heating are integrated and waste heat and cold will be re-utilized in the system. Heat recovery is one often-neglected area where plate heat exchangers can be profitably used.

There are large potential savings as soon as there is a demand for hot tap water or other types of heating at the same time as the cooling system is running. Some types of buildings where this may be the case are hospitals and hotels, or different production facilities, for example in the chemical, pharmaceutical and beverage industries.

Alfa Laval has many years' experience from both cooling and heating applications and from customizing this kind of optimized system.

The heat-recovery plate heat exchanger will be installed between the condenser and the cooling tower, recouping part of the energy that would otherwise be let out in the air. While recovering heat for pre-heating tap water, for example, the cooling need decreases on the condenser side. Thus the savings will not only be the energy recovered in the heating system, but also the energy not wasted in the cooling system. Due to the extreme efficiency of the plate heat exchanger it is possible to recover up to 95 percent of the energy that would otherwise be wasted. This is often more than enough to offset the capital and operating costs of the plate heat exchanger. In this case the heat exchanger should be of the double-wall type, with double walls between the condenser circuit and the tap water, to give extra protection against contamination.



Heat recovery is a good example of the kind of system optimization in which Alfa Laval has years of experience. In an optimized HVAC system waste heat from cooling can be used to warm for example tap water. With Alfa Laval plate heat exchangers it is possible to recover up to 95% of energy that would otherwise be wasted.

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100004920-1-EN 2111

Heat recovery

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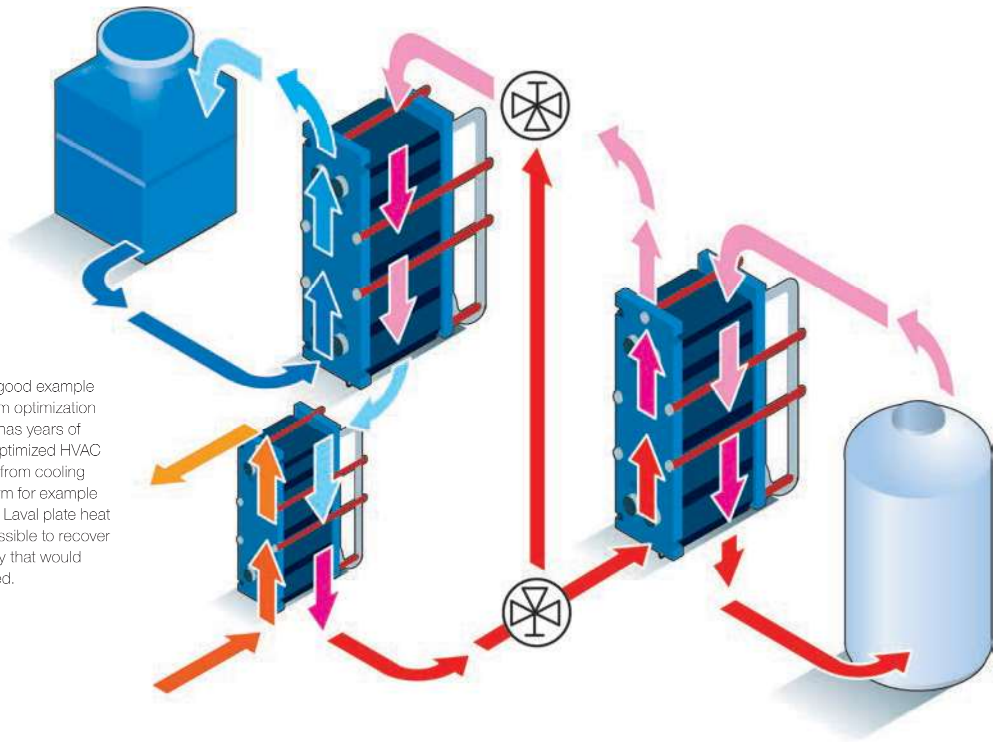

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100004920-1-EN 2111

Ice accumulator/storage

An ice accumulator/storage is a tank where ice can be accumulated during one period, stored and then thawed and used during another.

There are two main reasons for using an ice accumulator/storage:

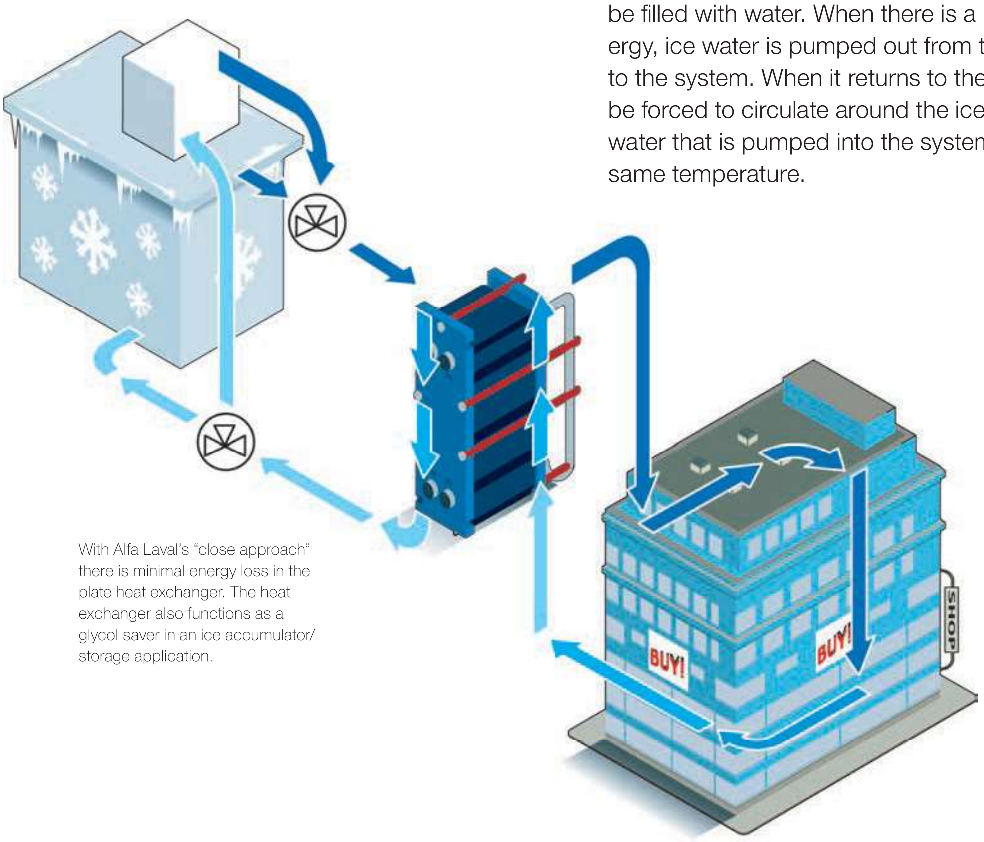
- Where the cooling requirements vary during the day a smaller chiller can be used. As a result the initial cost of cooling equipment can be reduced considerably.
- Cooling energy can be purchased during the night or off-peak hours. In many countries this means that it can be obtained at a lower price.

Since it has been shown that payback periods for ice accumulators will be as low as two years, it is an increasingly worthwhile investment. There are two main applications for ice accumulators: air conditioning and industry. Especially in industry, the cooling demand is often variable, for example in a dairy where the milk will be brought in in the morning.

Types of ice accumulators

There are two main types of ice accumulator systems:

- Systems with internal melting consist of a polyethylene tank containing coils of the same material. The container is filled with water. When ice is accumulated, a –5°C/23°F a glycol solution is run through the coil. The water will gradually freeze to ice, first around the coils and then further and further out in the tank. When the extra cooling capacity is required, the glycol solution in the coils will be led through the system and returned to the tank at a higher temperature. The ice accumulated in the tank will then melt, and the glycol solution will be recooled until all the ice is consumed.
- In systems with external melting the tank is made of steel or concrete. Here too are coils with glycol or a CFC/HCFC coolant, and ice is accumulated to a thickness of 35 mm/1.4 inches around each coil. The rest of the tank will be filled with water. When there is a need for cooling energy, ice water is pumped out from the bottom of the tank to the system. When it returns to the ice accumulator it will be forced to circulate around the ice. In this system, the ice water that is pumped into the system will always retain the same temperature.



With Alfa Laval's "close approach" there is minimal energy loss in the plate heat exchanger. The heat exchanger also functions as a glycol saver in an ice accumulator/storage application.

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100004922-1-EN 2111

Waste heat recovery

For many energy companies and municipalities there are untapped opportunities for using waste heat or surplus heat.

Such heat can be found in many forms, whether it is steam going out into the air or hot water going out into the ocean.

A lot of heat is lost in power plants, oil refineries and industrial processes. Many of these losses could be retrieved and distributed by district-heating systems to heat buildings. The same fuel achieves twice the work, thereby doubling fuel efficiency.

District-heating systems provide the necessary heat load for high-efficiency combined heat and power plants, while at the same time enabling the use of renewable energy. It demonstrates fantastic opportunities for other communities from a financial as well as an environmental point of view.

A residential building in Belgium, heated by surplus energy from a waste incineration facility.

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