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HVAC system optimization in industrial facilities

In the industrial sector, particularly the pharmaceutical industry, HVAC systems account for the largest share of total energy consumption at 65%. However, HVAC technologies are critical for production processes that require specific and constant temperatures to prevent the growth of bacteria and other contaminants. They are also essential for maintaining strict temperature, humidity, and air quality control. These sensitive applications require reliable and safe systems and advanced heating and cooling technologies.

In addition to areas dedicated to production processes, industrial facilities contain offices and other operational areas. It is therefore essential to control the temperature in these environments and provide hot water for daily use.

As mentioned above, HVAC systems are essential for providing air conditioning and temperature control throughout a building, making them a major contributor to energy consumption.

Capacity range

Cooling: From 10 kW up to 11000 kW

Heating: From 10 kW up to 2400 kW

Operating range

	Min	Max
Chilled water	-12 °C	30 °C
Heating water	30 °C	90 °C

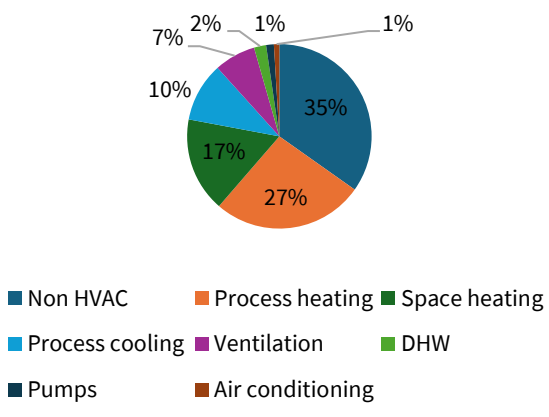

Figure 1. Final energy use

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It is crucial to ensure their reliability and proper maintenance over time, focusing on strategies to reduce energy consumption. Regarding the latter, the first step is to monitor consumption through an HVAC system audit, which provides a detailed load profile and identifies opportunities to optimize system efficiency. Concerning long-term reliability, it is indispensable to adopt advanced strategies and technologies that optimize performance extending the operational life of the systems. In the following paragraph, we will explore how these objectives can be achieved and the various solutions offered by Daikin.

Cooling system optimization

Containing operating costs is a key priority, closely linked to the need to reduce the environmental impact of installations. In cooling systems, most of the energy consumption is due to the operation of the chiller units. Daikin offers innovative solutions that reduce operating costs and environmental impact to meet these challenges, making installations more efficient and sustainable. Here are three reasons why choosing Daikin equipment can effectively meet these requirements:

Reason #1

Optimize performance at part loads

Partial loads account for over 95% of the operating time due to variations in ambient conditions. For this reason, it is essential to incorporate a Variable Frequency Drive (VFD) on the chiller compressor, which allows the compressor capacity to be modulated in response to changes in temperature and humidity. Daikin's in-house single screw compressor is a highly efficient component thanks to its integrated Variable Volume Ratio (VVR) technology. This feature enables the compressor to adjust its geometry to match the operating conditions, thereby increasing efficiency. In addition, the compressor's Variable Frequency Drive (VFD), developed and manufactured by Daikin, is mounted directly on the compressor and cooled by refrigerant, ensuring optimum performance and maximum reliability.

Reason #2

Free cooling to reduce energy consumption

Free cooling technology provides an additional and significant contribution to reducing electricity consumption. When outside temperatures are lower than the required cooling temperature, the chillers can switch off the compressors and use the cool outside air to cool the water, resulting in significant energy savings. Daikin offers a range of free cooling configurations with capacities from 150 to 2150 kW, including glycol-free systems that reduce energy consumption by optimizing the pumping system, resulting in additional operational savings.

Reason #3

Integrated active harmonic filter

Chillers can generate harmonic distortions that increase power consumption and energy costs, reducing system efficiency. Daikin offers a unique solution with integrated Active Harmonic Filters (AHFs) to mitigate these effects. The device is installed inside the electrical panel, cooled by the refrigerant from the chiller circuit ensuring temperature control in all operating conditions regardless of environmental conditions. These electronic devices are designed to reduce harmonic distortion in electrical systems by dynamically compensating for harmonic currents in real-time. AHFs continuously monitor the harmonic currents and generate compensating currents that cancel the distortions, improving the system's power quality and significantly reducing total harmonic distortion (THD).

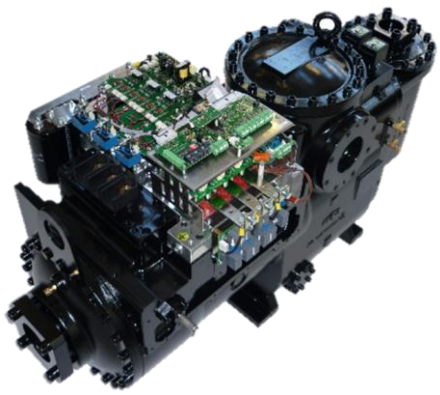

Figure 2. Daikin Inverter screw compressor

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Heating system optimization

Also, when it comes to heating systems, Daikin offers innovative solutions that promote sustainability and energy savings. Let's explore more reasons why choosing a Daikin product is a smart choice:

Reason #4

Use of heat pumps

The use of heat pumps in industrial buildings can meet different needs, such as space heating, process heating and domestic hot water production. However, according to recent studies heating demand is still almost exclusively covered by heat generated from gas, which remains the primary energy source. In this context, investment in heat pumps can lead to significant energy savings, as they are generally three times more efficient than traditional boilers. To meet these requirements, heat pumps must offer a wide range of capacities and operational flexibility. Depending on the product, Daikin heat pumps range from 10 to 2400 kW of heating capacity per unit and can provide hot water temperatures from 30°C to 90°C. The Daikin portfolio is highly flexible, offering different product configurations (air-to-water and water-to-water heat pumps) and compression technologies.

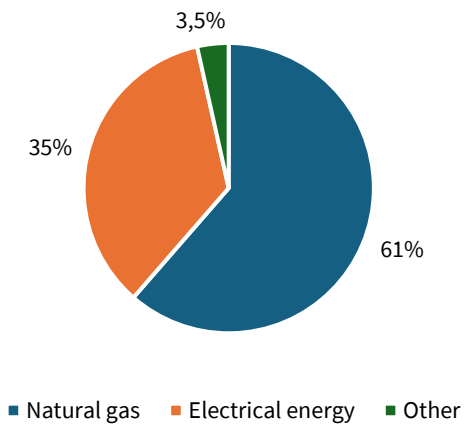

Figure 3. Energy use by carrier

Reason #5

Cascade systems

A Daikin cascade heat pump system is a solution that combines an air-to-water unit with a water-to-water unit that works together to achieve high supply water temperatures, making it ideal for refurbishment projects. However, in some cases, the use of a series of products may be the best option to achieve greater energy efficiency (e.g. lower running costs) and high hot water temperatures. These systems (cascade systems) can be optimally configured based on the project-specific operating conditions and requirements. To correctly set up the cascade configuration, it is essential to carefully analyse the project details. Daikin can assist with these evaluations, leveraging upon its broad product portfolio and extensive sales support expertise.

Reason #6

Exploiting the potential of heat recovery

It is common to find a simultaneous need for cooling and heating in industrial facilities. For example, space heating is needed in office spaces even where cooling of certain processes is required. Daikin can offer heat recovery solutions to reduce the running costs of HVAC systems. Heat recovery can be achieved while an air-cooled operates in mechanical cooling mode. This is obtained by installing a plate heat exchanger in series with the compressor. The recovered heat is then transferred to where required, for space heating, hot sanitary water production, or even a low-temperature district heating system. With the Total Heat Recovery option, water temperature can be raised up to 55°C. Hence, if needed, cascade systems can be designed, with a series of units depending on what temperature & efficiency levels must be achieved. That is, the air-cooled chiller can be combined in series with a water-to-water heat pump raising hot water from the heat recovery exchanger up to the desired temperature (75°C or even 90°C). A similar system can be designed with air-to-water heat pumps as well, raising water temperature up to 70°C, even at -20°C ambient temperature.

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Reason #7

Employing multi-purpose units

In industrial facilities, hospitals and hotels, there is often a need for simultaneous heating and cooling at all times of the year. This is where a **multipurpose unit** is used. This system is specifically designed to efficiently meet these requirements by analyzing the load profile of the building to determine the exact amount of energy to be supplied based on the distribution requirements. The Daikin EWYS-4Z multi-purpose unit is equipped with highly efficient single screw compressors with Variable Frequency Drive (VFD) and Variable Volume Ratio (VVR). These compressors, powered by Daikin's inverter drive technology, ensure reliable and sustainable performance. This unit features cooling and heating capacity from 400 to 800 kW, making it suitable and flexible for a variety of applications. The flexibility in different environments is ensured by the unit's capability to operate in ambient temperatures ranging from -18°C to +50°C. The chilled water temperature can range from -8°C, when using a water/glycol mixture, to +20°C, while the heating water temperature can vary between +30°C and +60°C. These specifications make the EWYS-4Z a versatile and energy-efficient choice for a wide range of heating and cooling needs.

Figure 4. EWYS-4Z multipurpose unit

Reliability of HVAC systems in industrial applications

All industrial processes, due to their complex and dynamic nature, require highly reliable and accurate HVAC systems and industrial machinery. Daikin's offer includes state-of-the-art technologies specifically designed to meet these reliability requirements through the following features:

Reason #8

Intelligent Chiller Manager (iCM) integration

To reduce the risk of operational disruption due to cooling system issues and further increase efficiency, Daikin offers the ***Intelligent Chiller Manager (iCM)***, a control solution designed to monitor and manage multiple units simultaneously, optimizing the performance of a group of chillers. The iCM harmonizes the operation of each chiller in the plant, allowing them to achieve their set points with minimum effort, both in terms of energy consumption and mechanical stress. The result is increased chiller life and efficiency, and savings in operating and maintenance costs. The iCM defines chiller's actions based on control logic, while also regulating the capacity of the chiller. In addition, the iCM can connect to Daikin's ***Daikin on Site*** cloud monitoring platform and communicate with most building management systems (BMS), ensuring seamless integration with building management.

Reason #9

Automatic Transfer Switches (ATS)

In the event of a power failure or breakdown, or to limit the impact of power interruptions on chillers' operation, it is recommended to employ electro-mechanical components such as Automatic Transfer Switches (ATS). Daikin can integrate ATS into its solutions. In addition to the ATS, it is also advisable to include other components to ensure that the chiller can quickly reach full capacity. One such solution is Daikin Rapid Restart, which includes a UPS that provides power to the unit controller for 180 seconds in the event of a power failure. When Rapid Restart is active, the compressor is reactivated within 30 seconds from power restoration (thanks to ATS) and the time to reach full capacity can be less than 3 minutes.

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Reason #10

Third-party certification

Daikin exclusively provides HVAC systems units under Eurovent and AHRI certification programmes, including free-cooling configurations of the latest product releases with **scroll** and **Inverter screw compressors**. Within these certification programmes, standards are set for manufacturers to be satisfied. These relate to the declaration of performance data and software applications used by manufacturers and their customers to simulate the performance of units under specific design conditions. The software is certified and submitted to regular testing for full and part load performances. Every product declared for certification can be subject to testing to validate performance data.

Figure 5. Water-to-water unit testing

Reason #11

Factory Acceptance Testing (FAT)

An important aspect of Daikin's reliability is the opportunity for customers to require and participate in **Factory Acceptance Testing** (FAT). This essential procedure ensures the proper commissioning of HVAC systems in industrial applications, certifying that the units meet the project requirements at specified ambient temperatures. FAT is a critical witness test that verifies the functionality and reliability of the unit before it is commissioned. By testing equipment before it is sold, customers can confirm that the equipment they intend to install will perform effectively in the operating conditions it will encounter.

Daikin Applied Europe's chiller factory is equipped with certified testing facilities, including a climatic test room capable of testing units up to 2000 kW cooling capacity. This facility evaluates chillers in a wide range of operating modes and climatic conditions, from extremely low temperatures (-18°C) to extremely high temperatures (+52°C). The test room operates to a rigorous set of procedures to ensure compliance with international standards set by certification bodies such as AHRI and Eurovent. As well, testing of water-cooled units is possible in dedicated test stands from 2 to 11 MW. These test stands are even AHRI certified.

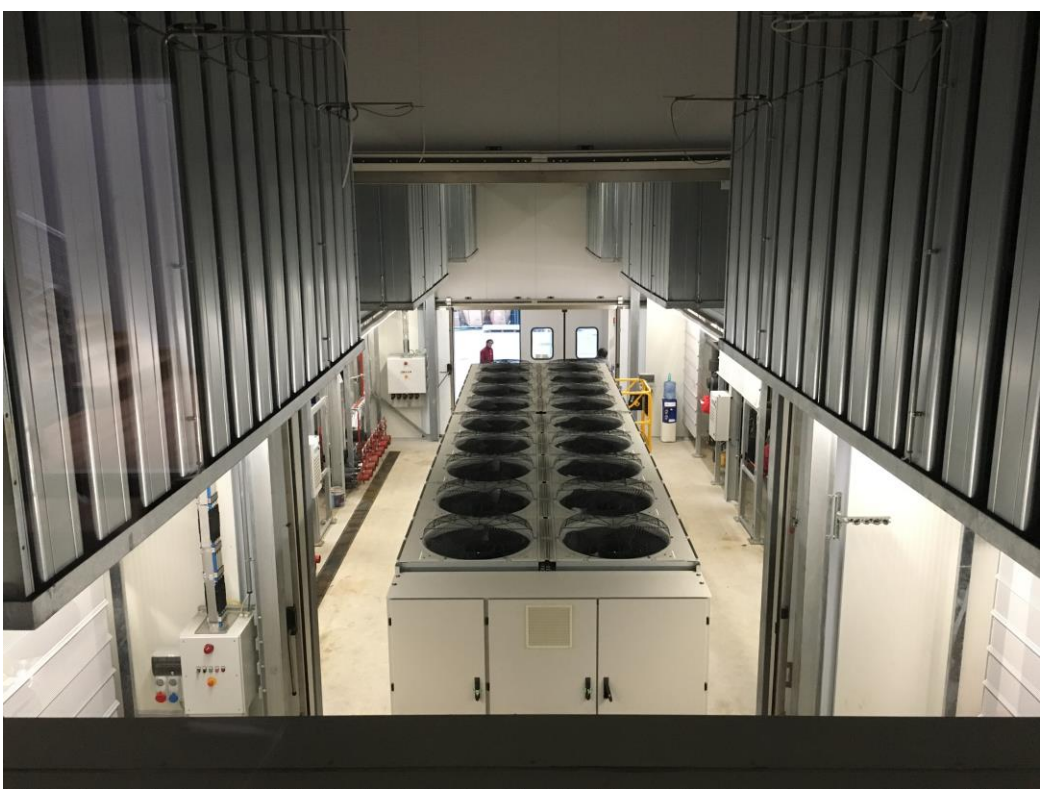

Figure 6. Climatic chamber (Cecchina factory)

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The need for consistent partners

To prevent breakdowns and service interruptions, Daikin offers preventive maintenance services for different equipment. Regular maintenance is essential to ensure the reliable operation of the system, guaranteeing consistent performance. The choice of HVAC products is, then, strictly related to the selection of a reliable partner. In this regard, Daikin offers its experience and expertise in the professional and efficient management of the processes required by large industrial groups.

Reason #12

Preventive maintenance plan

The reliability of a partner is measured by its ability to ensure the optimum and continuous operation of the system, avoiding recurring and long-term issues. Daikin offers a comprehensive range of services designed to maintain and improve performance. Among these, Daikin provides a ***preventive maintenance plan*** based on internal standards designed to prevent breakdowns and failures, avoid downtime and extend the life of the system. This plan details all the field activities to be carried out and the components to be inspected and replaced throughout the product's life cycle. This approach is the result of Daikin's extensive experience gained over 55 years of developing and manufacturing chiller technology at Daikin Applied Europe.

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Figure 7. Daikin's service technician

Reason #13

Daikin on Site (DoS)

Daikin on Site (DoS) service is another key element ensuring reliability, enabling real-time assessment of system operating conditions. This service identifies potential problems before they can affect the performance and reliability of the system, allowing advance planning of appropriate maintenance actions.

Daikin on Site is a cloud-based remote monitoring service for chillers and air handling units. This innovative tool provides remote monitoring, reporting, energy analysis and intelligent maintenance, giving detailed insight into system performance. The service provides real-time data, available 24/7, ensuring continuous monitoring and performance analysis of plant components. With instant alerts and the ability to make remote adjustments, it enables rapid identification and resolution of problems, improving asset reliability.

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