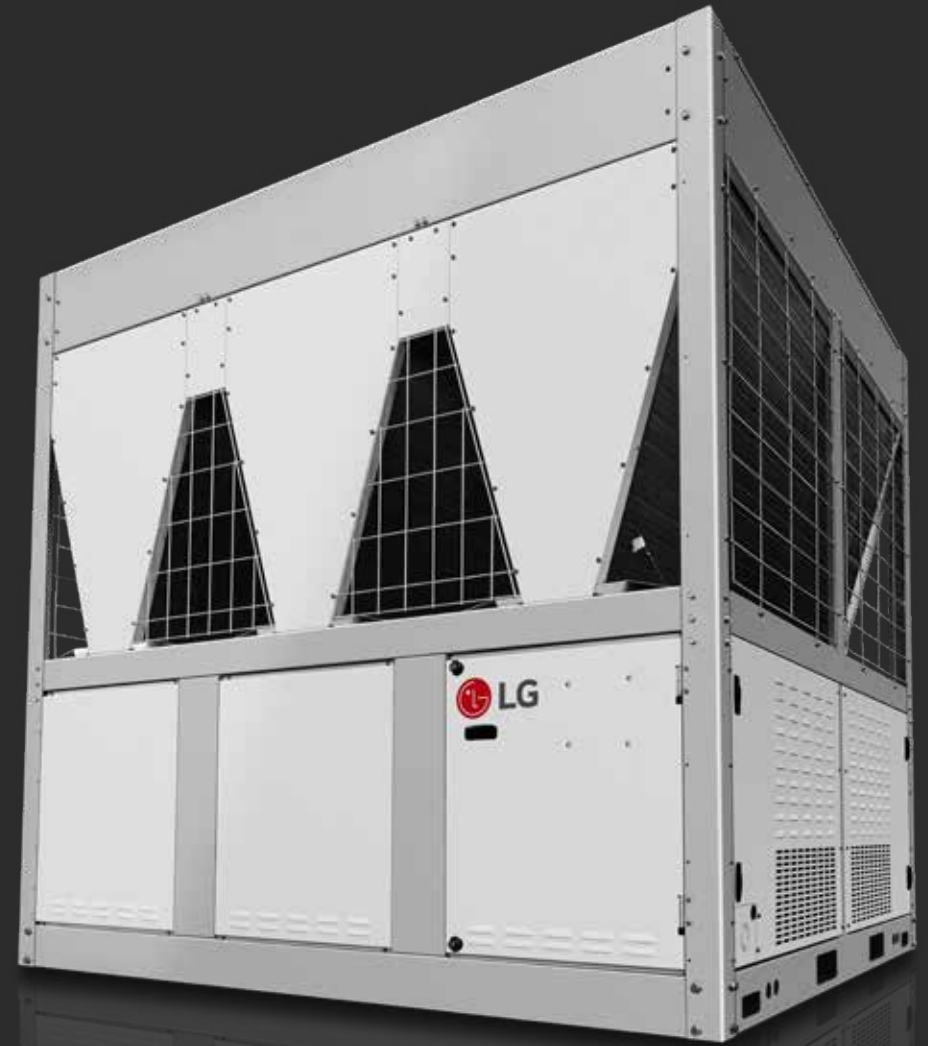


Revolutionizing Climate Control:
Efficiency and Flexibility of

Air-Cooled Inverter Scroll Chillers

This white paper explores LG's latest advancement in HVAC technology: the Air-Cooled Inverter Scroll Chiller with sustainable refrigerant. It delves into the innovative design and technology that make this chiller a game-changer in the industry.



Air-Cooled Inverter Scroll Chillers

White Paper

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Introduction

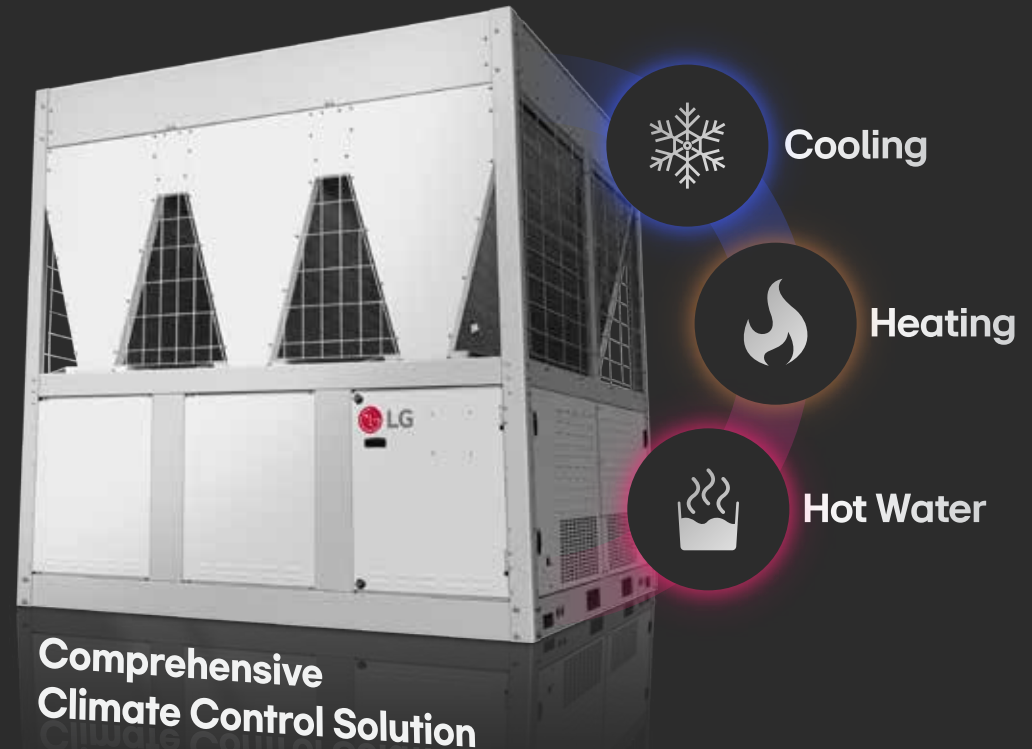
The global scroll chiller market is expected to grow from \$2,962 million in 2022 to \$3,981 million in 2032*, driven by their efficiency, environmental benefits, and versatility. Inverter Scroll Chillers (ISC) systems address heating, cooling, and hot water needs, aligning with the trend towards inverter and heat pump technologies for better energy savings. In this white paper, we will explore air-cooled inverter scroll chiller as standout products in this growing field. We will examine what makes the ISC unique, comparing it with air-cooled screw chillers to highlight its advantages. Additionally, we will discuss its applications across various verticals.

* Source: <https://www.businessresearchinsights.com/market-reports/scroll-chiller-market-102157#:~:text=Scroll%20Chiller%20Market%20REPORT%20OVERVIEW&text=The%20global%20scroll%20chiller%20market,3.0%25%20during%20the%20forecast%20period.>

What is an Inverter Scroll Chiller

The Inverter Scroll Chiller (or Inverter Scroll Heat Pump) offers a significant improvement over traditional VRF systems by directly producing chilled or hot water and supplying it to AHU (Air Handling Unit) or FCU (Fan Coil Unit) units. This method ensures a stable heat source while maintaining safety, as refrigerants do not enter indoor spaces. Additionally, it reduces refrigerant usage, making it more efficient. The system supports both heating and cooling, as well as hot water supply, providing comprehensive climate control solutions. Its innovative approach aligns with modern needs for safer and more efficient HVAC systems.*

*LG scroll chillers also require the installation of an additional heat exchanger for hot water supply.



a. A Chiller for Both Cooling and Heating?

Air-cooled inverter scroll chillers efficiently provide heating, cooling, and hot water, reducing the need for separate systems and simplifying maintenance. Their versatility makes them suitable for residential, commercial, and industrial applications. Air-cooled scroll chillers are adaptable for diverse settings, including schools, hospitals, offices, swimming pools, and hospitality, providing precise temperature control in factories and smart farms. Their all-in-one solutions enhance energy efficiency and streamline operations across various applications.

The image below illustrates how ISC systems integrate the capabilities of both conventional boiler systems and VRF systems, as well as screw chillers, providing comprehensive solutions for heating, cooling, and hot water supply. This integration allows ISC systems to be versatile, meeting diverse application needs across various facility types from residential, commercial to industrial. This versatility makes ISC systems highly suitable for a wide range of applications, ensuring optimal performance and energy savings in different settings.

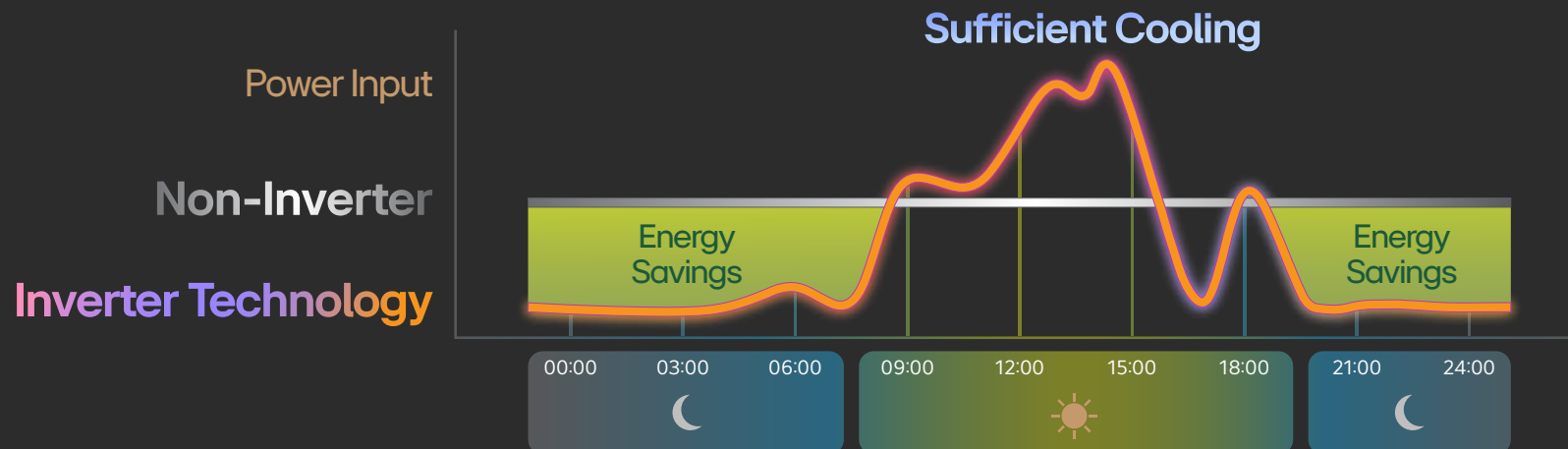


b. Chillers with Inverter Technology vs Non-Inverter Chillers

In HVAC systems, inverters play a crucial role in enhancing the system's responsiveness and reducing energy consumption, especially during periods of partial load. When comparing inverter chillers to non-inverter chillers, the key difference lies in how they manage load variations.

Inverter systems are particularly efficient at partial loads, adjusting output to match cooling demand, which reduces energy consumption and costs while precisely controlling the temperature and maintaining a consistent indoor environment. This adaptability enhances overall performance, aligning with Integrated Part Load Value (IPLV) and seasonal cooling efficiency concepts.

In contrast, non-inverter chillers operate at a constant speed, turning on and off to meet the cooling demand, which leads to higher energy consumption and less efficient performance. The benefits of inverter technology include improved energy efficiency and performance, particularly in varying load conditions.



Scroll Chillers vs Screw Chillers

There are fundamental differences between air-cooled scroll chillers and screw chillers, impacting their suitability for various applications. Let's delve into these differences better to understand the technology and performance of each type.

a. Compressor Technology

The type of chiller is largely determined by the compressor technology it employs, making it crucial to understand the characteristics of each compressor to grasp the differences between the two chiller types.

Scroll chillers utilize scroll compressors, which function using two interleaved spiral scrolls to compress the refrigerant. One scroll remains stationary while the other orbits, creating pockets of refrigerant that are compressed as they move toward the center. This motion resembles a vortex, hence the name "scroll." This method of refrigerant compression enhances energy efficiency, particularly under partial load conditions, and ensures high performance. Additionally, scroll compressors have fewer moving parts, which reduces friction and wear, simplifying maintenance due to their simpler structure.

In contrast, screw chillers use screw compressors equipped with two helical screws rotating in opposite directions. As refrigerant enters, it becomes trapped between the rotors and is compressed as the screws turn. This technology is well-suited for handling significant cooling loads. The refrigerant moves in an axial (longitudinal) direction as it rotates and compresses, giving rise to the name "screw." Screw chillers offer consistent performance and high reliability due to their continuous refrigerant compression characteristics. They are particularly advantageous in large cooling capacity scenarios and high-load conditions.

Furthermore, the refrigerants commonly used in these compressors differ. Air-cooled scroll chillers typically use R410A and are transitioning to R32. On the other hand, air-cooled screw chillers predominantly use R134a but are currently transitioning to R513A.

Scroll Compressor



Refrigerant

R410A · R32

Principle

Two spiral scrolls to compress and discharge refrigerant

Feature

Highly efficient with fewer parts, compact, and valveless design

Compressor Capacity

Small to Medium-Sized

Screw Compressor



R134a · R513A

Two rotating rotors to compress and expel refrigerant

Large-scale, high-speed, high-compression, low-temperature applications

Medium to Large

b. Installation

Chiller systems are often selected over VRF systems for larger-scale installations due to their capacity to handle substantial cooling loads. Chillers can also leverage existing piping infrastructure in building with water piping already installed, which simplifies the chiller installation process. However, the installation process varies significantly depending on the type of chiller.

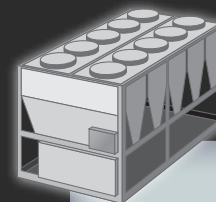
Scroll chillers are compact and, given their smaller capacity, are ideal for small to mid-sized applications. While they can be used in larger facilities, doing so would require more units, thereby increasing space requirements. Despite this, scroll chillers are relatively easy to install due to their simple structure and fewer components. Their lighter weight means that foundational work is minimal or unnecessary, and electrical and piping connections are straightforward. This makes the installation process quicker and less labor-intensive compared to screw chillers.

Screw chillers, in contrast, are generally heavier and bulkier than scroll chillers, necessitating more extensive foundational work and meeting more stringent structural requirements for the installation site. Although they occupy more space, screw chillers can handle larger cooling loads with fewer units, which simplifies large-scale installations. This makes them more suitable for high-capacity installations such as large commercial buildings and industrial facilities. The robust nature of screw chillers ensures reliable performance in demanding environments.



Air-Cooled Scroll Chiller

- ✓ **Compact Size:**
Ideal for applications where rooftop space is limited
- ✓ **Simpler Installation:**
Due to their lightweight and straightforward design, installation is uncomplicated
- ✓ **Replacement:**
Leverage existing water pipes



Air-Cooled Screw Chiller

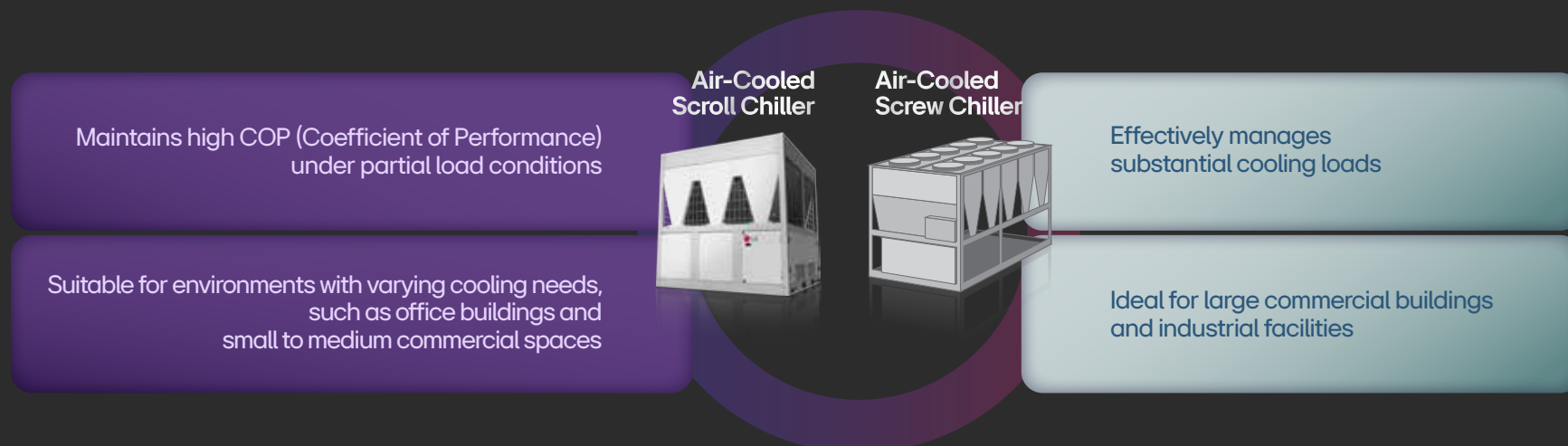
- **High Capacity:**
Capable of handling large cooling loads efficiently with fewer units
- **Installation:**
Suitable for large commercial and industrial facilities
- **Replacement:**
Leverage existing water pipes

c. Energy Efficiency

Scroll chillers and screw chillers differ significantly in structure and operating principles, which leads to variations in energy efficiency. Each chiller type has its strengths in different load conditions, influencing their suitability based on the intended application. Let's compare the energy efficiency of these two systems.

Scroll chillers excel in small to medium-sized applications with variable cooling demands, maintaining high efficiency and a high COP even under partial load conditions. Their simple design minimizes mechanical friction, leading to energy savings and lower operational costs. This makes them ideal for environments with fluctuating cooling needs, such as office buildings and small to medium commercial spaces compared to screw chillers.

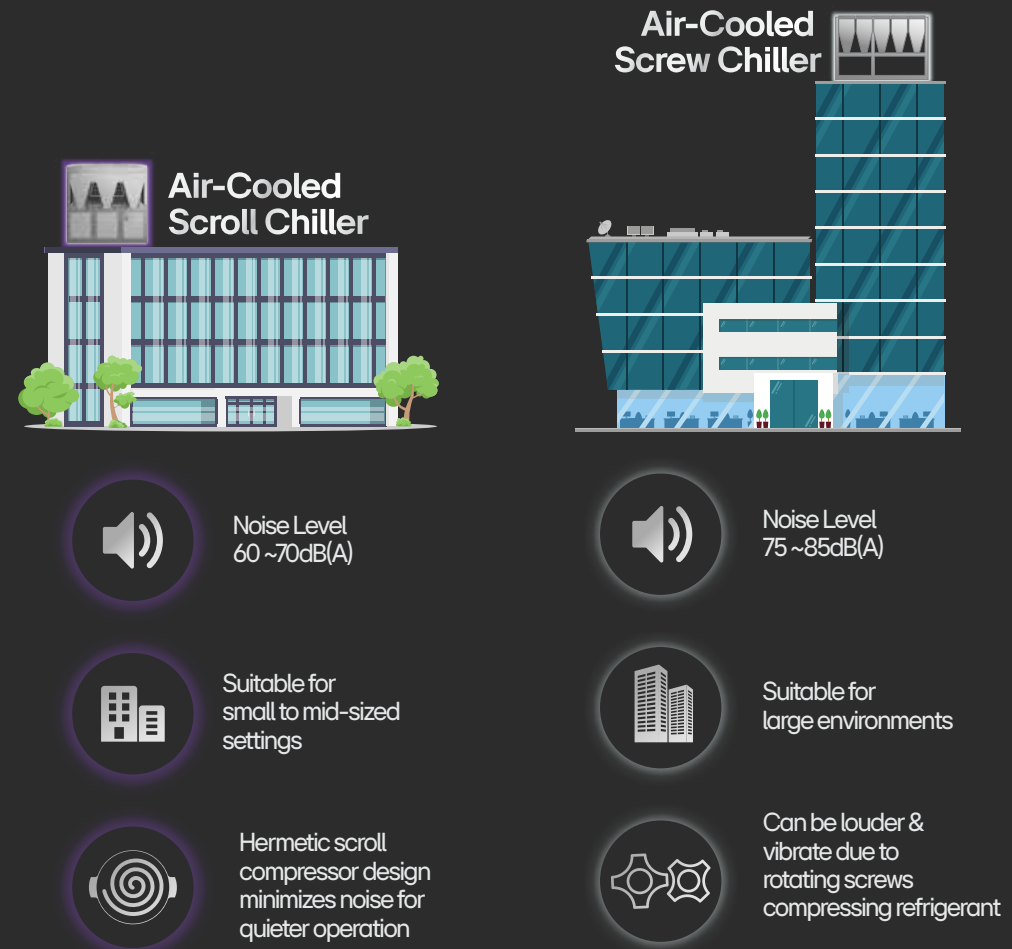
Screw chillers, on the other hand, excel in larger capacities and can effectively manage substantial cooling loads. Their reliability is crucial for large commercial buildings and industrial facilities. However, screw chillers are generally less efficient at partial loads compared to scroll chillers, making them less ideal for applications with variable demand. To mitigate this, technologies such as Variable Frequency Drives (VFDs) – a type of inverter technology - can be employed to enhance their efficiency under varying conditions.



d. Noise and Vibration

Scroll chillers operate with minimal noise and vibration due to the smooth, continuous motion of the scrolls, making them suitable for noise-sensitive environments. Typically, noise levels range between 60-70dB(A), which is acceptable for residential and office settings. The uniform compression provided by the rotating scrolls results in minimal imbalance, reducing the need for additional vibration control devices. Furthermore, the hermetic design of the scroll compressor prevents internal noise from escaping, ensuring a quieter operation.

In contrast, screw chillers tend to be louder and produce more vibration due to the nature of their operation, where two screws interlock and rotate to compress the refrigerant. Noise levels generally fall between 75-85dB(A), which is acceptable in large commercial environments but may require alternative solutions in residential or noise-sensitive areas. The mechanical interaction of the screws generates vibration, necessitating the use of vibration absorption devices or rubber pads to mitigate the impact. This additional requirement highlights the need for careful consideration when installing screw chillers in environments where noise and vibration are critical factors.



e. Maintenance

The maintenance process for ISC systems is streamlined and efficient due to their simple and compact design. These chillers use hermetically sealed compressors, which means the internal components are enclosed and protected, reducing the likelihood of contamination and wear. Consequently, ISCs do not require an overhaul, as the hermetic sealing eliminates the need for regular disassembly and reassembly.

Additionally, the fewer moving parts in scroll compressors minimize mechanical friction and wear, leading to less frequent maintenance checks and lower overall maintenance costs. This simplicity in design and reduced maintenance workload make inverter scroll chillers a highly convenient and time-efficient solution for HVAC needs.

In contrast, screw chillers, which use semi-hermetic compressors, require more intensive maintenance processes. The semi-hermetic design necessitates periodic overhauls to inspect and replace internal components, ensuring the system remains operational and efficient.

The higher number of moving parts in screw compressors, such as the interlocking screws, increases the potential for wear and tear, requiring more frequent maintenance checks. Moreover, disassembling and reassembling the compressor during overhauls adds complexity and time to the maintenance process.

f. Scroll Chillers vs Screw Chillers with Boilers

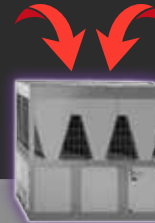
Chillers are primarily utilized for cooling facilities. However, chillers are also capable of heating functions, particularly when they are integrated with heat pump technology.

Scroll chillers incorporate heat pump technology that operates efficiently in both cooling and heating modes as well as hot water supply*. During heating, the refrigerant flow reverses to absorb heat from the outside and release it indoors. This integrated heating capability eliminates the need for additional boilers, simplifying maintenance and reducing both costs and installation time.

* LG scroll chillers also require the installation of an addition unit for hot water supply.

The system maintains high efficiency in heating mode, similar to its performance in cooling mode. Since it operates entirely on electricity, it requires no additional fuel supply lines or exhaust systems, making upkeep easier and eliminating the need for regular cleaning or combustion byproduct disposal.

Air-Cooled Scroll Chiller



1. Absorbs heat from the outside

2. Releases heat inside



No Need for
Additional Boilers



Simplifies
Maintenance



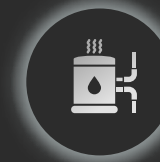
Reduces Costs &
Installation Time



Operates Entirely
on Electricity

Screw chillers can also provide heating when integrated with heat pump technology, but they are primarily used in conjunction with boilers. These boilers heat water directly using fossil fuels or electricity, and the hot water or steam is then distributed through heating pipes to radiators, underfloor heating systems, or air heaters. This configuration requires fuel supply lines and exhaust gas systems, making the installation more complex and costly compared to scroll chillers. Despite this, boiler systems can produce very high-temperature water and offer reliable heating even in extremely cold climates.

Air-Cooled Screw Chiller



Mainly Used with Boilers



Fuel Supply Line, Exhaust Gas Pipe Installation Required



Supplies High Temperature Hot Water



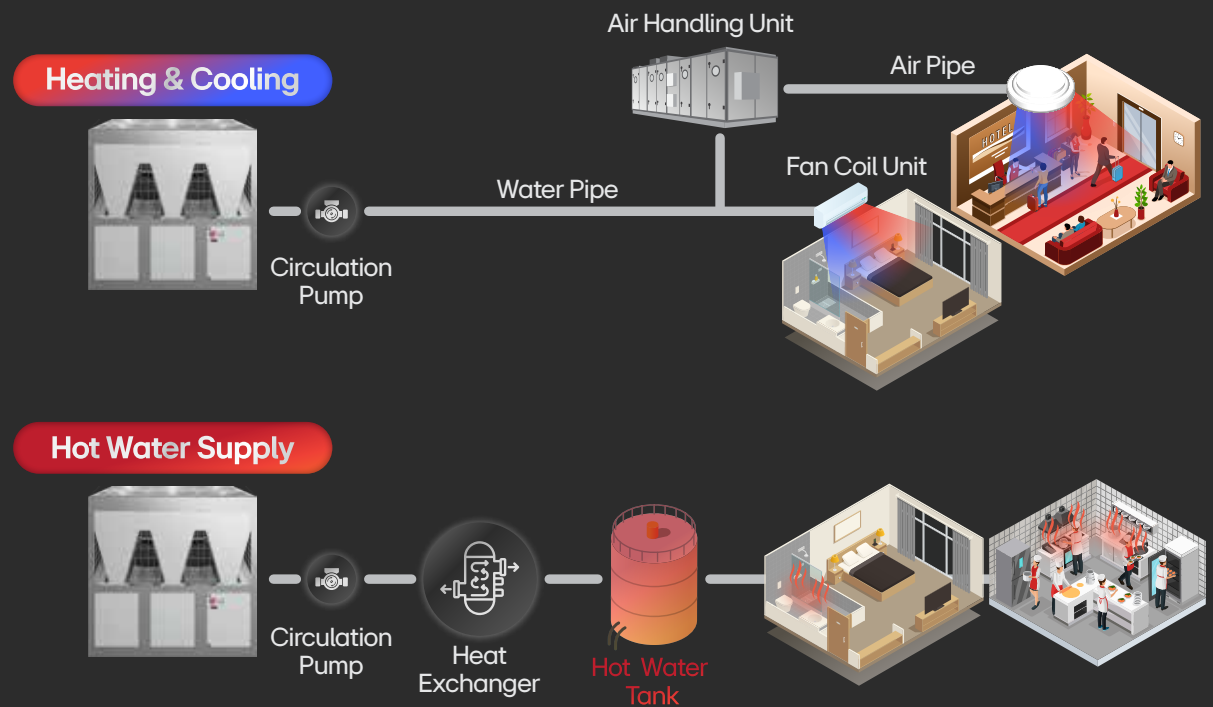
Provides Stable Heating even in Extremely Cold Climates

Versatile Applications and Key Considerations

There are fundamental differences between air-cooled scroll chillers and screw chillers, impacting their suitability for various applications. Let's delve into these differences better to understand the technology and performance of each type.

a. Hospitality

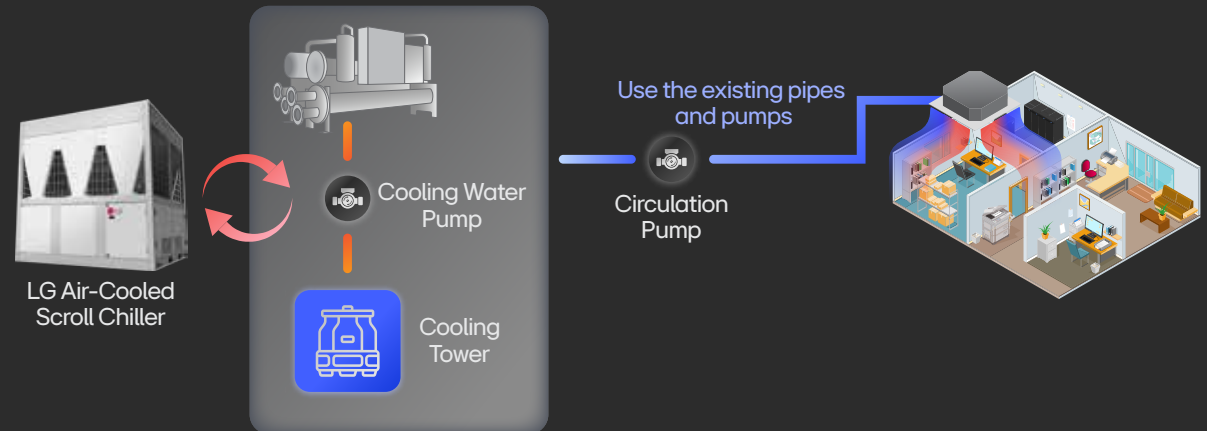
In the hospitality sector, properties often feature separate areas for guest rooms, restaurants, and common facilities such as saunas and fitness centers. Air-cooled scroll chillers offer an ideal solution by providing precise heating, cooling, and hot water for these diverse spaces. Their ability to deliver targeted climate control ensures comfort in guest rooms, efficient temperature regulation in restaurants, and adequate hot water supply for recreational areas. This adaptability helps meet the varying demands within a hotel or resort, enhancing guest satisfaction and operational efficiency.



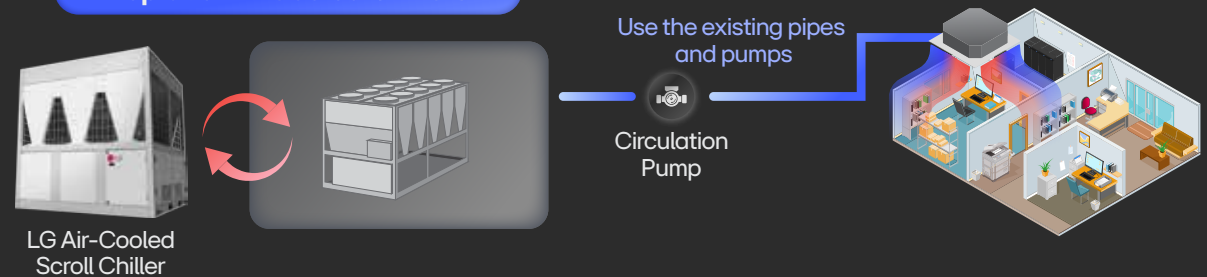
b. Schools, Offices, and Hospitals

These facilities primarily require reliable heating and cooling, with minimal demand for hot water. Air-cooled scroll chillers can easily replace existing water-cooled or air-cooled chillers and can also substitute traditional boilers. Additionally, scroll chiller systems can use existing water pipes in facilities that already have water piping installed, making installation easier and less cost intensive. Their efficiency in maintaining a stable indoor environment supports a conducive learning atmosphere in schools, a comfortable working environment in offices, and a hygienic setting in hospitals. The ease of integration with existing systems simplifies upgrades and enhances energy efficiency, leading to reduced operational costs.

Replace Water-Cooled Chillers



Replace Air-Cooled Chillers





Increases Energy Efficiency



Precise Temperature Control



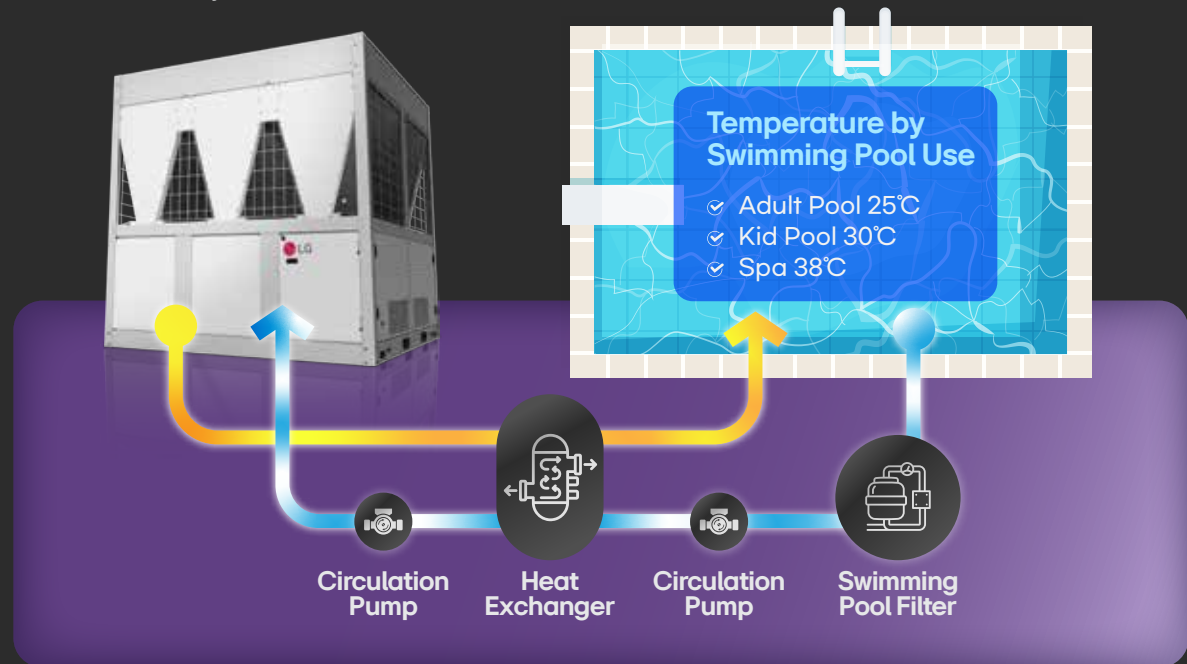
Reduces Operational Costs



Sustainable Solution

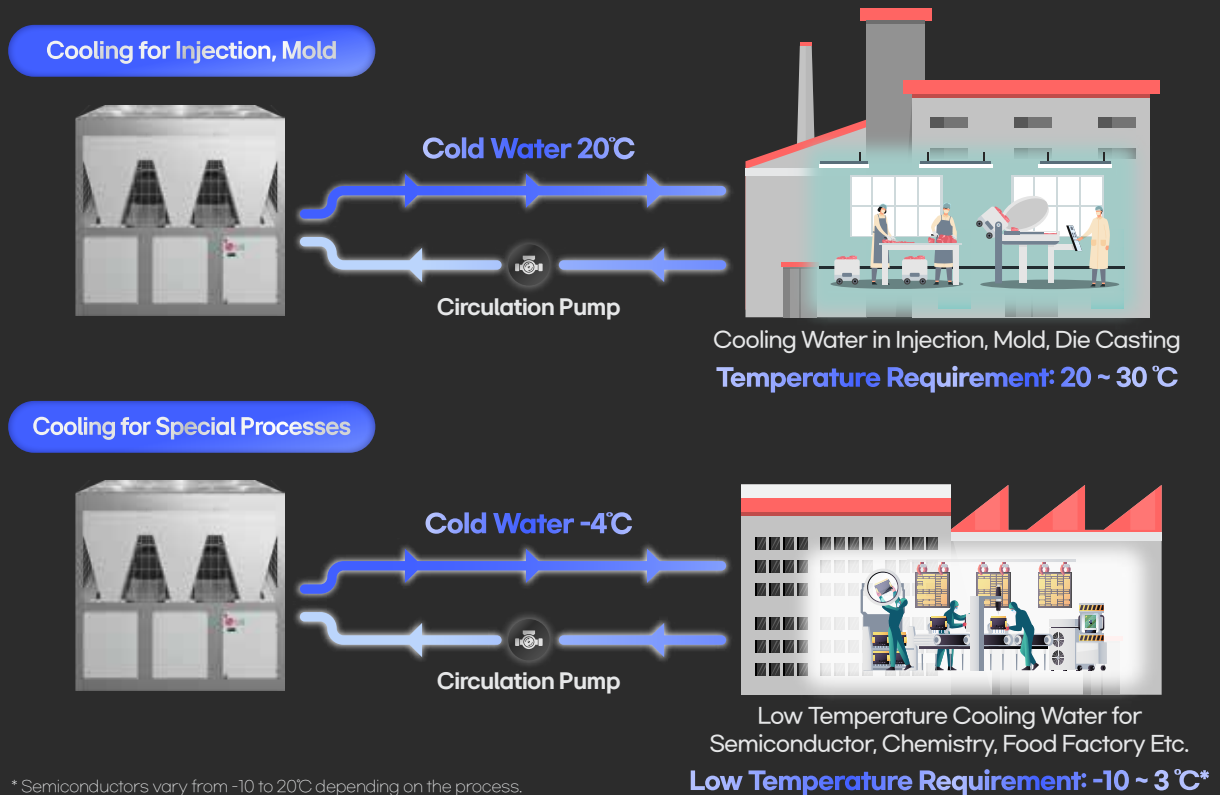
c. Swimming Pools

Swimming pools necessitate a consistent supply of hot water for pools and showers. The Inverter Scroll Heat Pump is particularly suited for this application due to its efficiency at moderate temperature requirements (25°C-30°C). When replacing traditional boilers, these heat pumps offer a faster payback period thanks to their energy-saving capabilities. This leads to significant cost reductions while maintaining the desired water temperature, ensuring a pleasant experience for swimmers and bathers.



d. Factories

Factories present varied temperature requirements for different processes and purposes, alongside high energy usage. Air-cooled inverter scroll chillers are versatile enough to meet these needs, providing a wider temperature range for cooling and hot water. This adaptability translates to cost and time savings by addressing multiple thermal management needs. By optimizing energy usage, factories can improve operational efficiency and reduce their overall carbon emissions.



e. Smart Farms

Smart farms leverage IoT and big data to create optimal growth environments, necessitating both heating and cooling with high energy demands. Replacing traditional boilers and air heaters with Inverter Scroll Heat Pumps can significantly reduce operating costs. These heat pumps provide precise temperature control, essential for maintaining ideal conditions for plant growth. The resulting energy efficiency and cost savings support the efficiency and profitability of smart farming operations.



Reduces
Operational
Costs



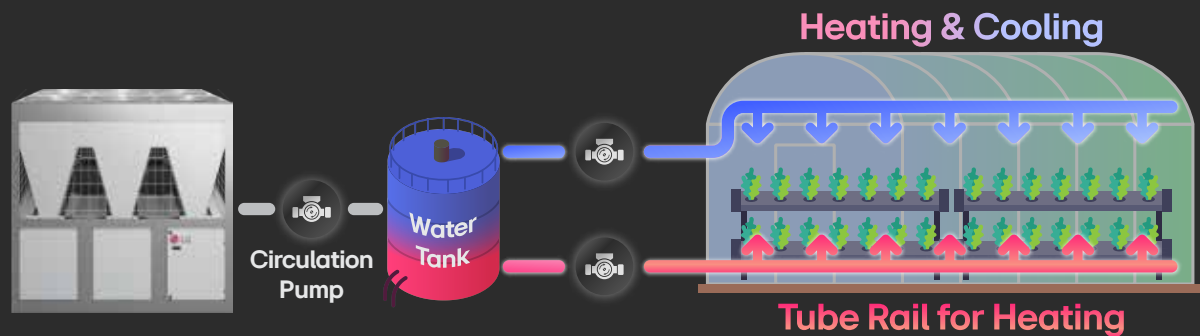
Precise
Temperature
Control



Smart
Farming
Operations

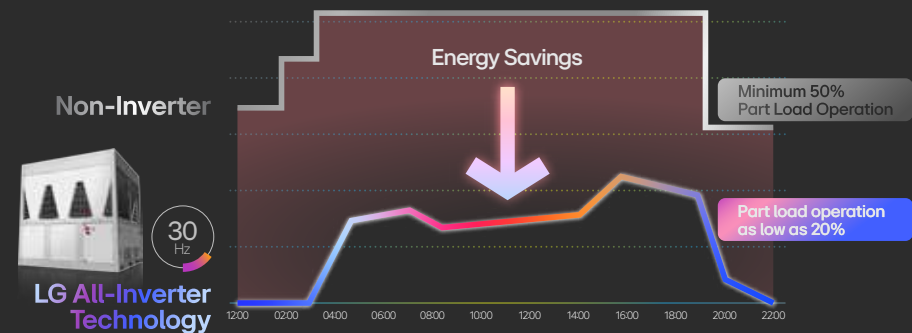


Sustainable
Solution



Unique and Innovative Advantages of LG Inverter Scroll Chillers

LG's Air-Cooled Inverter Scroll Chillers distinguish themselves in the market with several advanced features and technological enhancements. A key differentiator is LG's All Inverter System, which integrates inverter-driven motors in all major components, such as compressors and fan motors. This system allows the chillers to operate at variable speeds, tailoring power consumption to meet actual demand. As a result, the chillers achieve higher efficiency, especially under partial load conditions, leading to significant energy savings compared to constant-speed systems. This dynamic adjustment capability allows the chiller to provide optimal performance across various usage scenarios.





Compact
Design

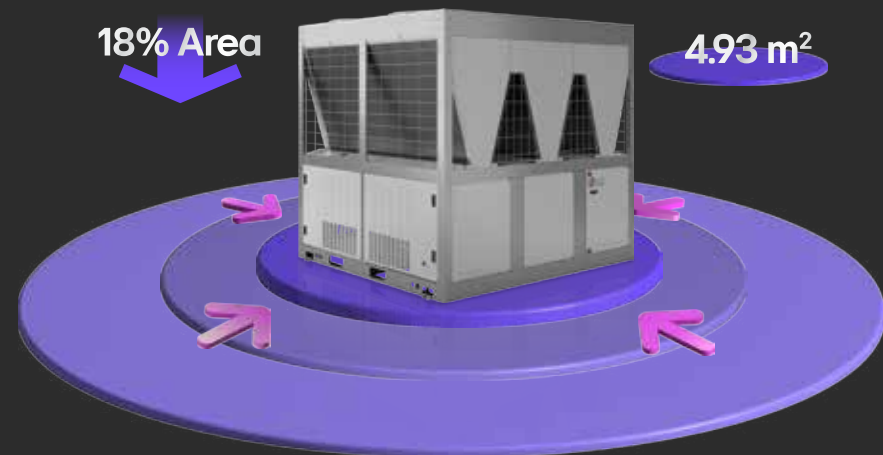


High
Efficiency



Flexible
Installation

Another major advantage is the compact design of LG's Inverter Scroll Chillers. Their small footprint makes them easy to integrate into diverse settings, whether for retrofitting existing systems or designing new installations. Impressively, ISC systems generally have a footprint that is 18% smaller* than other solutions for 60RT installations. This compactness is particularly beneficial in environments where space is limited, allowing for flexible installation without sacrificing performance. The ease of integration simplifies the planning and installation process, making these chillers a versatile choice for commercial and industrial applications.



* The footprint comparison of the LG INVERTER SCROLL CHILLER series is made against C company's 30RC series model and Y company's YLAA series model, based on an equivalent capacity range of 60RT.

Moreover, LG's Inverter Scroll Chillers utilize R32 refrigerant, which significantly enhances energy efficiency and overall performance. R32 refrigerant has a lower global warming potential compared to traditional refrigerants, contributing to reduced environmental impact.* The adoption of R32 allows LG's chillers to meet current and future regulatory requirements for a more efficient alternative for HVAC applications.

Notable regulatory changes such as the EU F-Gas regulations aim to curb the use of high GWP refrigerants. In the US, the EPA will prohibit the sale of new air conditioning systems and heat pumps that utilize refrigerants with a GWP of 700 or higher from 2025 in residential and light commercial sectors.** This forward-thinking approach based on the market environment makes it possible for LG's Inverter Scroll Chillers to remain at the cutting edge of HVAC technology.

* R410A has a GWP of 2,088, while R32 has a GWP of 675.

** Source: <https://www.epa.gov/climate-hfcs-reduction/technology-transitions-hfc-restrictions-sector>



Conclusion

The growth of the scroll chiller market underscores their energy efficiency, environmental benefits, and versatility in meeting diverse HVAC needs. Inverter Scroll Chillers, with their advanced inverter technology, offer superior energy efficiency and performance across various applications. When compared to screw chillers, scroll chillers provide unique advantages in terms of installation ease, noise reduction, and adaptability to different environments. Leveraging these strengths, they are well-suited for both small-scale and large-scale installations, making them a valuable solution for modern HVAC systems. As industries continue to prioritize energy savings and operational efficiency, the adoption of scroll chiller technology is poised to expand significantly.

Product Line-Up

I Air-Cooled Inverter Scroll Chiller

RT		17 ~ 23	33 ~ 45	50 ~ 67
Unit				
Capacity (kW)	Cooling	57 65 74	114 130 148	171 195 222
	Heating	60 70 82	120 140 164	180 210 246

* Product availability and specs for the LG Air-Cooled Inverter Scroll Chiller may vary by country. Please check with your local LG representative.



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