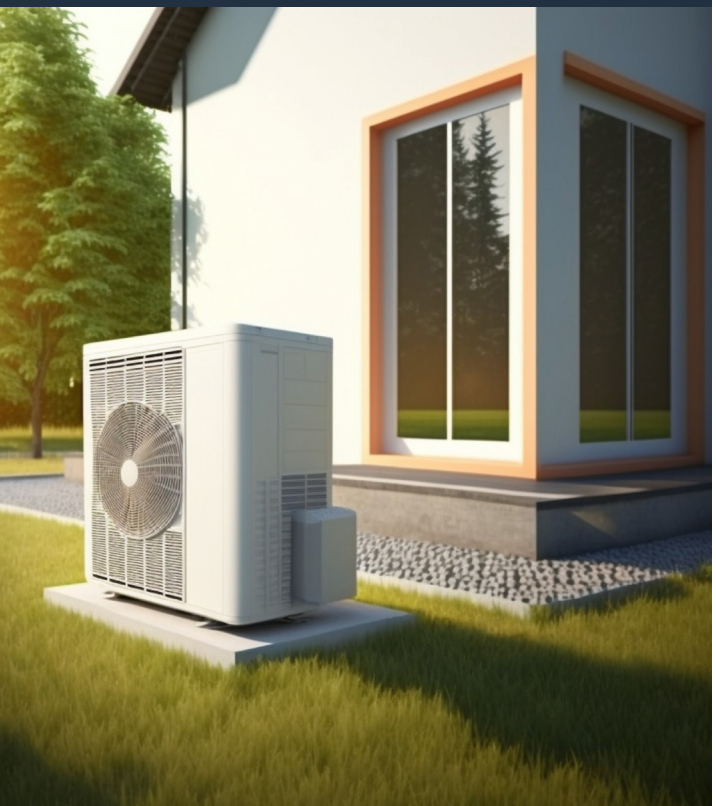
Sensata Technologies

HVAC IN TIME OF TRANSFORMATION: HEAT PUMPS AND REFRIGERANT CHANGES DRIVE CLIMATE CHANGE EFFORTS

The U.S. Energy Information Administration estimates that the energy used to cool residential and commercial buildings accounts for a full 10% of total electricity consumption



Sustainability is one the central issues facing the planet at this time.

Countries around the globe have each set out aggressive targets to reduce their greenhouse gas emissions – either through the Paris Agreement or through other means, with complementary goals driven by states, provinces, or other local approaches.

That focus on sustainability has also carried into the corporate world, with companies everywhere looking to integrate more earth-conscious choices into their priorities. A full 81% of the world's top companies report on sustainability as part of their corporate priorities, and 90% of companies in the S&P 500 issued a sustainability report in 2021.

This extends to everything – their facilities and buildings, their manufacturing processes, and their products. And in each of those strategies, industrial sensing can play a key role in helping to drive change across a number of pathways.

HEAT PUMP EXPANSION

Electrified heat pumps are quickly replacing natural gas and oil-fired boilers – a key tactic in reducing the impact of climate change.

In 2022, global heat pump sales increased more than 11% - two straight years of double-digit growth – and now account for roughly 10 percent of today's heating needs in buildings. In the United States in 2022, heat pump purchases exceeded those of gas furnaces. In other parts of the world, expansion was even more pronounced. In Europe sales increased almost 40 percent.

There are many reasons around that trend – the first of which is that it eliminates the need to burn fossil fuels on site at each building. So instead of burning natural gas, the energy to heat the building comes from the electrical grid.

Of course, energy from the grid often comes from some of the same sources – and it also has to overcome losses during transmission along the electrical grid. To make up for that, heat pumps need to be tremendously efficient – and they are. While criticism around heat pump performance in colder climates was valid in past decades, today countries in Scandinavia and other colder regions have some of the highest adoption rates worldwide.

Today's heat pump designs can generate five times the heat compared to a traditional electric heater with the same amount of electricity – which allows them to overcome grid losses and create a net-negative impact on overall emissions from power generation.

As solar power and other renewables continue to expand (and more and more electricity is generated locally), that transmission loss impact will be less and less of a factor – magnifying the energy savings from the heat pump system itself.

However, even the rapid growth of heat pump systems in recent years is not enough to meet the world's climate change goals. To stay on the path to net-zero emissions, the amount of building heating done by heat pumps will need to double – going from 10 percent in 2022 to 20 percent in 2030.

Countries around the world have created a variety of incentive programs and regulations to push heat pump technology. Many countries – such as France, Austria, and the United Kingdom – have passed bans on installing boilers in new buildings in the future. Other have created tax incentives and loan programs to help fuel the switch, or even looked at increasing taxes on fossil fuels such as natural gas.

https://www.iea.org/commentaries/global-heat-pump-sales-continue-double-digit-growth

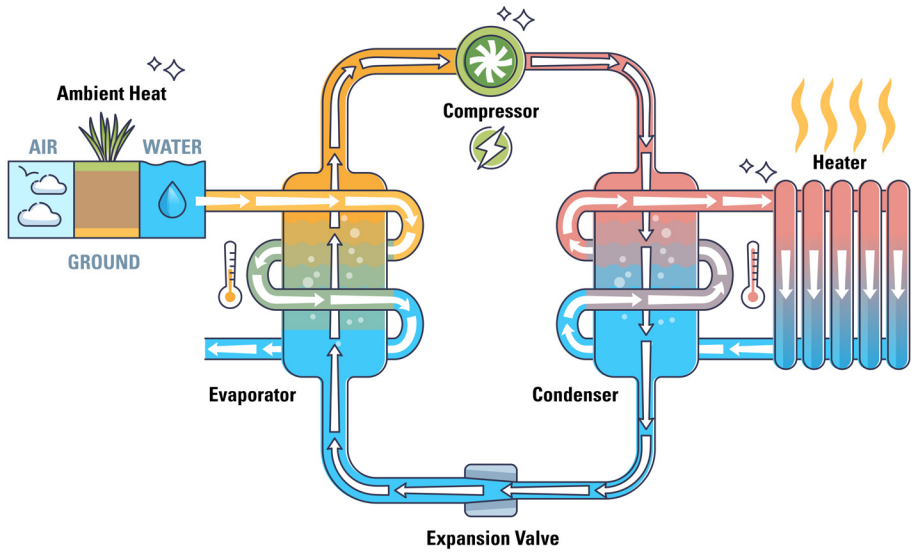
SHIFT IN REFRIGERANT STRATEGIES

In addition to the growth of heat pumps, shifts in HVAC refrigerants have also been a focus area of the industry due to potential climate impacts.

Heat pumps and other HVAC platforms function by manipulating the pressure of a refrigerant to alter its temperature and change its state from a liquid to a gas. Different than a traditional air conditioning unit, however, heat pumps are bi-directional. The system can compress the refrigerant outside and cause it to absorb heat from an exterior source and bring it into the home to heat the air or hot water tank through the hydronic loop. But it can also utilize a reversing valve to achieve the opposite – compressing the refrigerant inside the home to serve as a heat sink, cooling that air and transferring the heat energy outside during warmer months.

Various platform solutions around the world use a variety of refrigerants based on their specific application and other environmental needs.

While systems in past decade may have used hydro-fluorocarbon (HFC) compounds, the high global warming potential (GWP) of those refrigerants has led to the development of other options. Those shifts were behind the Kigali Amendment to the United Nations' Montreal Protocol – legislation originally developed to ban chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs), which were impacting the ozone layer in Earth's atmosphere.



Gradually reducing the consumption and production of hydrofluorocarbons (HFCs).

Under the Kigali Amendment – which the United States ratified in September 2022 – developed countries such as the U.S. would phase out HFCs over time, reducing their use by 80 to 85 percent by the late 2040s, with other countries following different schedules. By 2100, the overall effort will have hopefully helped to avoid up to 32.9°F of global temperature rise.

The dynamics of the shift have varied widely by region. Many systems across Europe utilize R290 (also known as propane) as the refrigerant, while others may utilize CO_2 or other refrigerant blends such as R454a (sometimes referred to as A2L refrigerants). These compounds are grouped under the term A2L because of their rating according to ISO 817.

Chemicals in category A3 are considered less toxic, but highly flammable – such as propane. While chemicals at B1 may not be flammable, they are toxic. A2L chemicals are slightly flammable but are less toxic.

A2Ls have been used in the European Union, Japan, India, Australia, and the auto industry for some time. But as the advantages of using A2L systems became more clear, regulatory bodies made adjustments to account for their use in commercial and residential HVAC systems, with regulations such as ASHRAE 15-2019 and UL 60335-2-40.

In order to burn, A2L gases would need to leak, reach concentrations above the chemical's lower flammability limit, and then be exposed to an open flame or other ignition source. To prevent this, much of the regulatory focus has been on the preventing and detection of leaks within a given system.

Leak detection systems must detect when the concentration of refrigerants is approaching a percentage of the lower flammability limit of the specific compound, venting the gas and preventing a buildup.

These leak detection systems must withstand very challenging environmental conditions – high in condensation with significant temperature extremes - without needing additional maintenance or calibration over a planned 15-year equipment life. In addition, many chemicals used in servicing HVAC equipment may use oils or other chemicals which may foul some detection systems.

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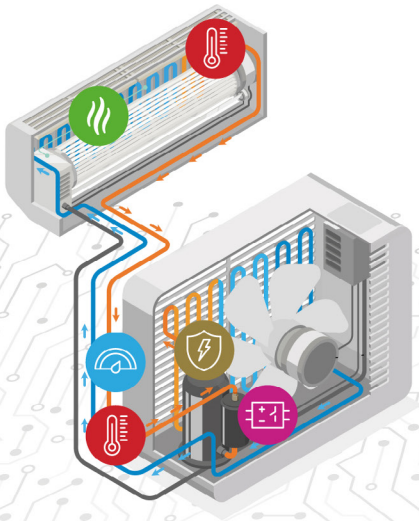
MAKING THE WORLD HEALTHY TOGETHER

Our broad range of sensing and protection solutions enable safe, efficient and environmentally friendly HVAC/R equipment



Pressure Switches

Reliable switching of the refrigerant line pressure

Pressure and Temperature Sensors

Monitoring of refrigerant pressure and temperature

New: A2LDetection

Gas Leak Sensors

High-accuracy leak detection of A2L refrigerants

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Solid State Relays

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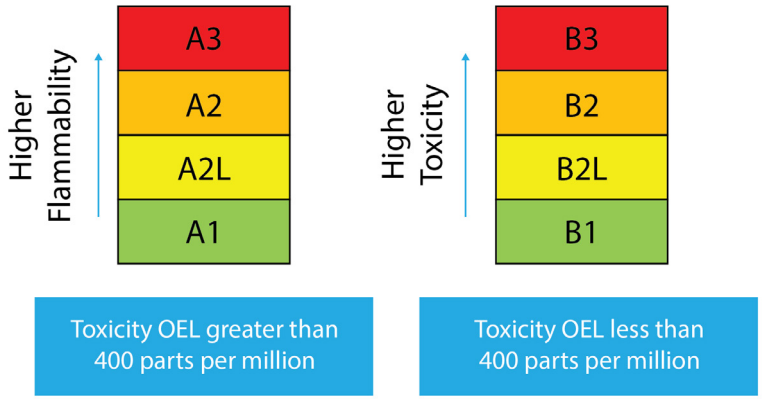
First A2L Leak Detection Sensor Certified for Multiple Refrigerants

In the U.S., these designs will be needed for new HVAC systems. starting in 2025. Sensata's RGD leak detection sensor was the first to receive recognition by UL under 60335-2-40 for multiple refrigerants - R32, R454A, R454B, and R454C. It also received fully certified test results for vibration, oil spray, and response time – critical evidence for OEMs facing tight regulatory timelines.

The sensors deliver a fast response time with a life expectancy of more than 15 years – often exceeding the lifetime of the equipment itself. Because the sensors do not require field calibration or re-zeroing, they reduce service costs for both installers and end users. They are also unaffected by fouling gases, HVAC cleaning solutions, and continuous refrigerant exposure.

Similar UL approvals are also needed for systems running on R290/propane. However, because propane is an A3 refrigerant – with a much tighter lower flammability limit – the detection systems for those equipment designs must be significantly more sensitive.



THE ROAD AHEAD

The elevated focus on HVAC as a key factor in climate change efforts is expected to continue in the coming years and decades, as commitments and deadlines made by countries around the world shift from long-term aspirational goals to practical, attainable targets.

While some of the stated targets and programs designed around them may shift due to new developments or other trends, the guiding principle of reducing the amount of energy used for heating and cooling of the next generation of electrified buildings will remain.

ABOUT US

Sensata Technologies is a global industrial technology company striving to create a cleaner, more efficient, electrified and connected world. Through its broad portfolio of sensors, electrical protection components and sensor-rich solutions which create valuable business insights, Sensata helps its customers address increasingly complex engineering and operating performance requirements. With more than 21,000 employees and global operations in 16 countries, Sensata serves customers in the automotive, heavy vehicle & off-road, industrial, and aerospace markets.

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