

Expert Article Radiant cooling in residential buildings

**Lucia Schiavio, Director Product Marketing,
Uponor Building Solutions Europe, Frankfurt/Main**

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➤ Cooling systems for increased comfort

Ensuring pleasant indoor temperatures in summer is becoming ever more important in residential buildings: due to climate change, the number of hot days per year is rising – and comfort in the home through good cooling system becomes a key argument when selling or letting a property. A cooling system increases the value of a property, but it should be as energy-efficient as possible in order to avoid compounding the climate change problem and to keep ancillary costs as low as possible. 'Silent radiant cooling', located beneath surfaces within the room, is regarded as particularly appealing, boasts excellent energy efficiency and guarantees an optimal comfort level for the residents.

Temperatures will significantly increase

From now on, three factors will shape the development of heating and cooling systems for residential properties in Europe: climate change, the resulting need to save energy, including in the building sector – and the dramatic rise in the sale of heat pumps. When it comes to sales figures per 1,000 households in a comparison of European countries, even Germany, which still lags behind Scandinavia, France, Spain and Italy, witnessed a rise in sales of almost 40 per cent last year, with the number of heat pumps in planning approvals exceeding the 50 per cent mark.

Various studies on vulnerability to climate change, e.g. in Germany and Switzerland (ROGEK), indicate that there will be a significant increase in temperatures above the comfort threshold of 26°C in indoor spaces and that the energy needed for cooling will, in the future, exceed the energy needed for heating. In a

nutshell, the issue of cooling in summer is becoming ever more important, also in residential buildings. As a result, future-oriented temperature control within buildings must include both heating and cooling while being as energy-efficient as possible.

Additional costs associated with investing in systems capable of cooling need to be weighed against significantly improved levels of domestic comfort and can be recouped through sale and letting, as the demand for cooling systems in private residential properties will rise appreciably. It is therefore worth incorporating a radiant cooling system in new builds – or at least making preparations for one – from the outset. When planning such systems, it is important to consider a few points regarding design, execution and room temperature control.



➤ A feel-good climate all year around in the home through good cooling system becomes a key argument when selling or letting a property.

Optimum use of space

In new builds, a radiant cooling system can be installed under the floor or behind a wall or ceiling. In residential properties, underfloor cooling is the most commonly seen option, as it is usually relatively easy to use the planned underfloor heating system for cooling too. Wall heating is usually a custom solution that complements an underfloor heating system or that features in renovation projects. In light of the ongoing decline in heating loads, most rooms in new builds can now also easily be heated via the ceiling; a major benefit of ceiling systems is their high cooling output. Ultimately, the planner's choice of system hinges on the

required output. By virtue of the physical properties of warm air, the cooling output of an underfloor system is the lowest and that of a ceiling system the highest (see table 1). But even an underfloor system is effective enough when it comes to providing sufficient cooling in today's well-insulated new builds. In longer and warmer periods of good weather, radiant temperature control prevents the build-up of heat by reducing the extent to which building mass heats up; surfaces are kept cooler, and residents even perceive higher ambient air temperatures as more agreeable.

Radiant temperature control system	Cooling output
Underfloor heating + tiles	Approx. 40 W/m²
Underfloor heating + carpet/parquet flooring	Approx. 30 W/m²
Wall cooling	Approx. 70 W/m² (*)
Ceiling cooling	Approx. 100 W/m² (*)
(*) limited by a minimum surface temperature of 17°C	

Table 1: Typical cooling outputs of radiant temperature control systems.

The issue of heat in attics

On warm days, there is considerable build-up of heat in attic apartments. As a result, residents often regard the ambient temperature as uncomfortable. This may lead to complaints and, in certain circumstances, to demands for rent reduction. One solution comes in the form of radiant cooling systems,

which are installed in the plasterboard behind sloping roofs and ceilings. They are highly effective, as cool air sinks. Ideal systems include the ultra lightweight Uponor Siccus heating and cooling system or the practical, modular and highly energy-efficient Uponor Renovis system.



Wall and ceiling heating systems like Uponor Renovis can complement an underfloor heating system. Besides, they are especially interesting when modernizing attics.

Ready for cooling

If the radiant heating system is also to be used for cooling or if preparations are to be made for this purpose, certain aspects need to be considered in the design phase. First of all, it is recommended that the pipe distance will be reduced, ideally down to 10 cm. As the cooling system operates with a lower differential, the pressure losses in the heating circuits need to be adjusted; the solution in this regard is to shorten the heating circuits or increase the pipe diameter. Usually, it is more straightforward to replace a 14 mm pipe with a 16 mm or

17 mm pipe than to increase the size of the manifold. In order to prevent condensation, it is also important to insulate the manifold's inlet pipes so that they are vapour-tight. The cooling output also depends on the flooring above. Tiles, for instance, enable a greater cooling output than carpets or parquet flooring. If a heat pump is used as the energy source, these systems also offer another benefit: they improve the seasonal energy efficiency ratio (SEER) in respect of heating.



Uponor Smatrix room temperature control technology can effectively control both heating and cooling. The Smatrix Pulse variant also scores with its Smart Home functions.

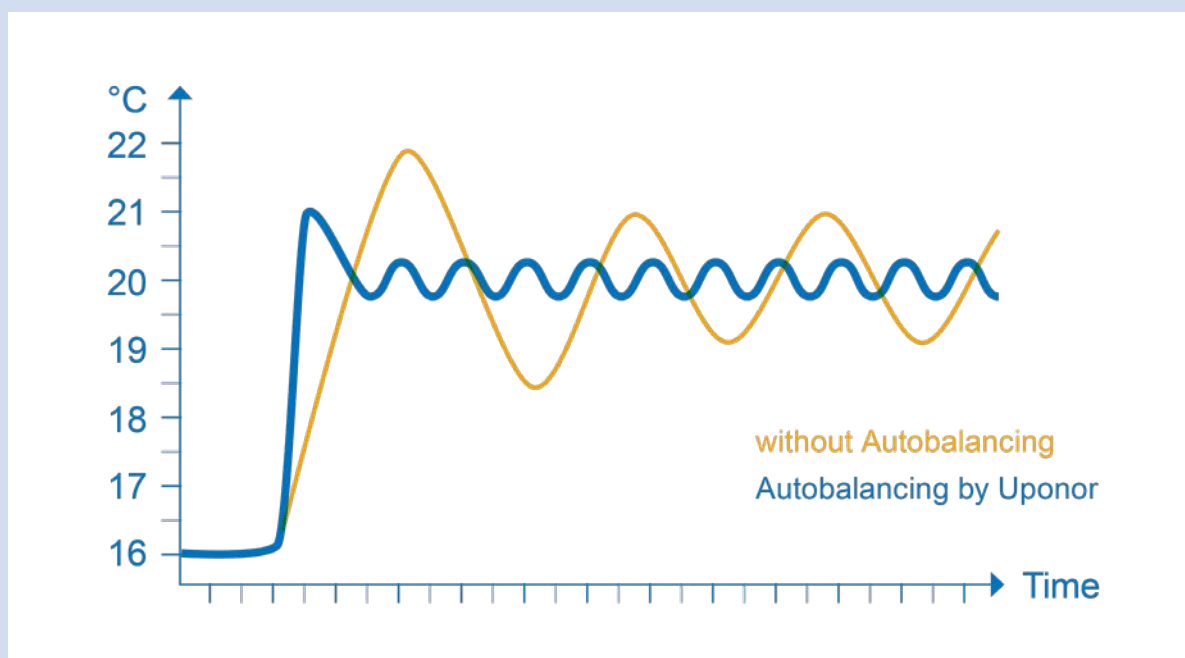
The room temperature control technology factor

In the event that the room temperature control for the radiant heating system is also used for cooling, its technology has to be 'cooling-ready', thus facilitating a switch from heating to cooling as required. Systems such as Uponor Smatrix Pulse control technology open the manifold valves for summer cooling when the ambient temperature rises – i.e. working on exactly the opposite principle as in winter. In heating mode, the valves close when the ambient temperature rises.

As in the case of heating, a system is particularly efficient when it is optimally configured in terms of hydraulics. For practical reasons, radiant cooling systems are often operated using the same hydraulic settings that apply to heating. This is problematic, as heating and cooling are not influenced by an identical set of factors. Whereas potential heat loss (e.g. through the building's outer shell) is the main factor to be considered in respect of heating, cooling is chiefly influenced by the

amount of direct sunlight, with windows and their shading equipment playing a crucial role. As such, individual rooms may exhibit vast differences between the heating load in winter and the cooling load in summer. The room's usage represents another vital factor. In the bedroom, for example, we only want to heat a little in winter so that a pleasant temperature is maintained for sleeping. The heating circuit's output is therefore reduced. In summer, however, the opposite applies: as we need the room to be cool enough to sleep, we have to cool more intensively. A system that is manually set for heating cannot enable optimum cooling, as the volumetric flow rate is too low. This problem is bypassed using automatic calibration. Control systems such as Smatrix Pulse use open valves, meaning that the maximum volumetric flow rate is available for cooling in rooms such as the bedroom.

The process of switching the system from heating mode to cooling mode – with all the



The auto-balancing function of the Smatrix room control continuously monitors the temperature conditions in the individual rooms and adjusts the hydraulics to the changing conditions.

► If the underfloor heating system is also being used for cooling, the installation clearance should be reduced to 10 cm.



Lucia Schiavio
Director Product Marketing
at Uponor



Ensuring summer comfort

Pleasant, year-round ambient comfort in multi-occupancy buildings can be achieved in an energy-efficient manner using a radiant temperature control system in combination with a bivalent heat pump. System providers such as Uponor offer systems that meet the requirements in order to harness existing room arrangements in an efficient manner. An important factor in this regard is the professional planning of the overall system,

which includes correct calculation of the heating and/or cooling loads, selection of suitable surfaces and the professional completion of all tasks involved. As a result, investors and property owners benefit from a sustainable and long-lasting heating and cooling system.

adjustments this entails – is completed within about three hours. A variety of factors influence when the system makes the switch. Uponor Smatrix Pulse control systems allow the user to define a room as a reference room; this means that the measurements recorded by the room sensor, i.e. the ambient temperature of the room concerned, trigger an output signal. As a result, the switch takes place using a reversible heat pump, for example, or a set of three-way valves on a four-pipe system. In this case, heat and cool air are permanently available on every manifold – and the user can adjust the settings to decide for themselves when their system should switch between heating and cooling.

Alongside the benefit of automatic calibration, a system with single-room regulation also makes it possible to individually adjust the temperature of each room when cooling.

With conventional systems, cooling is usually based on a reference room. The system switches itself off for the entire building once the desired temperature or the relative humidity threshold has been attained in this room, even if other rooms could still be cooled further. The Smatrix Pulse room control system, on the other hand, draws on the temperature and humidity data of individual room sensors, such as the Uponor T-169. If the relative humidity threshold is exceeded in a single room – the factory setting is 75 per cent and can be individually adjusted – the system can stop cooling for the room concerned.

Single-room regulation thus improves the potential cooling output. As in the case of heating, the control system thus ensures permanent monitoring of the factors influencing radiant temperature control and can, if necessary, automatically adjust the mass flow rate.

Green living in the City

The „Holzwohnen“ project in Vienna, Austria, shows how an underfloor heating system can also provide pleasant temperatures in summer. For the new construction of an upscale apartment building in solid timber construction, the investor focused on ecological living and a comfortable climate all

year round. Accordingly, the decision was made in favour of an energy-efficient radiant heating system in combination with a heat pump using geothermal energy. A total of 1,400 square metres of Uponor Tacker system were installed in the 21 rental flats.



Moving ➤ Forward

Uponor is a leading international provider of solutions that move water for buildings and infrastructure. We're rethinking water for future generations with our safe drinking water delivery systems, energy-efficient radiant heating and cooling systems, and reliable infrastructure solutions. With a commitment to sustainability and a passion for innovation, we're developing new technologies and systems that build confidence and enrich people's lives.

That's moving forward.
And that's what Uponor is all about.

uponor

Building Solutions Europe
Franklinstraße 61-63
60486 Frankfurt am Main

T +49 (0) 9521 690 57
www.uponor.com