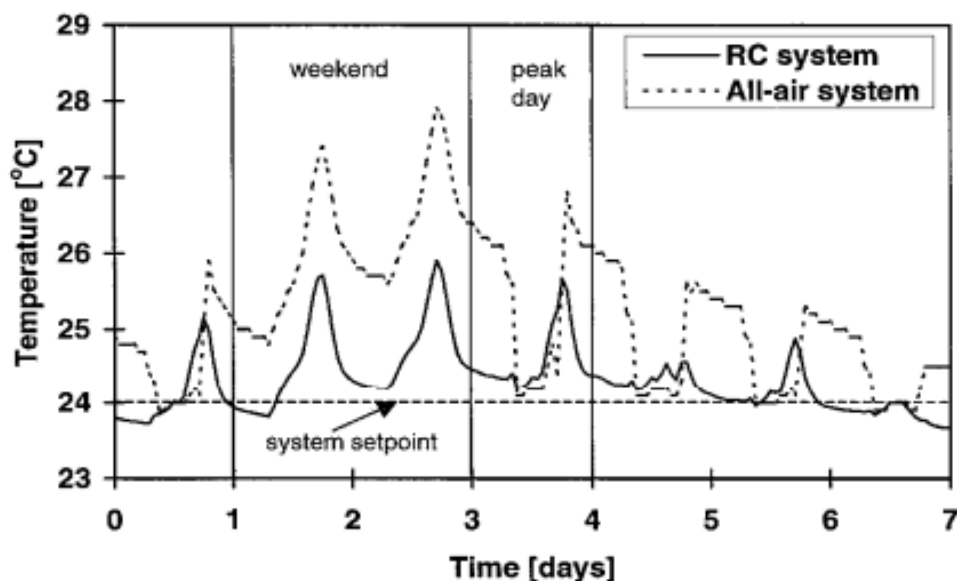


Well-Being

Well-being is part of social sustainability - looking after the occupants of buildings. Thermal comfort is a key contributor to an individual's well-being and Radiana can contribute significantly to this by:

- A reduction in cold draughts. Because Radiana does not use cold air to cool, cold draughts are reduced because there is no excessive air movement. Ventilation is separated from cooling so significantly less air flow can be used for the ventilation component.
- Better vertical air temperature gradient. With traditional systems there are often complaints about the temperature between the head and foot. Radiant cooling systems, like Radiana, have been shown to provide much more comfortable and smaller thermal gradients¹⁻³.
- More stable temperature control; Studies have shown that 24 hr temperature fluctuations are much lower with a radiant cooling system compared to an all-air system^{4,5}.
- Better occupant satisfaction; Many studies have shown that satisfaction of people living or working in radiant cooled building is higher⁶.

FIGURE 1 GRAPH SHOWING BETTER TEMPERATURE STABILITY FOR RADIANT COOLING ACROSS THE DAY



WELL v2

WELL™ is the leading tool for advancing health and well-being in buildings globally¹⁷. Emanating from America it is being adopted in the UK for buildings where well-being is a real focus.

The next version of the WELL standard, WELL v2¹⁸, has been developed, the new standard gives specific credits to thermal comfort and Radiana can contribute specific credits in this area:

- Thermal zoning. Credits for multiple zones and individual control.
- Radiant Thermal Comfort. Credit is given to 'Hydronic radiant heating and/or cooling systems' if at least 50% of the project floor area is serviced by this system.
- Humidity Control. Credit is given if the mechanical system has the capability of maintaining relative humidity between 30% and 60% at all times.

Note that traditional air systems are not eligible for credits for radiant thermal comfort.

Energy efficiency/carbon footprint reduction

Air-conditioning, globally, is a significant contributor to greenhouse gas emissions.

It is estimated that cooling in air-conditioning systems may account for around a tenth of total UK electricity consumption. In a typical office, air conditioning can account for over 30% of annual electricity consumption.

The energy consumed by the air cooling sector, globally, is set to increase by 90% by 2050. Full air conditioning will be demanded in more buildings to control summer temperatures. The energy demand from air-conditioning is high and is going to get higher. Therefore, the consumption of fossil fuels will also increase and therefore carbon emissions.

Refrigerants used in air-conditioning are much more potent greenhouse gases than carbon dioxide (by 1-3 thousand). It has been reported that leakage from air conditioning is thought to contribute significantly to the global warming impact of air conditioning systems.^{7,8} The EU has a target to reduce non-CO2 greenhouse gas emission from 2005 to 2050 by 60%.

Radiana can contribute to global energy reduction and reduced climate change impact in a number of ways.

Radiana can contribute to Energy reduction

A large part of the energy requirement for a traditional all-air system are the electric fans/motors required to move the cooled air around the building. This is energy intensive and can account for up to 50% of the energy costs of air conditioning systems.

Radiana uses water rather than air as a cooling medium and this has a key advantage. Water can transport 3500 more heat than the same volume of air, therefore the energy required to transport the cooling medium can be significantly reduced if water is used. It has been reported that transport energy can be reduced by up to 25% by using a RC system⁹.

Secondly, Radiana uses the heat pump/chiller more efficiently and this saves additional energy. All types of air conditioning need something to remove the heat from the building - this is most commonly a chiller or heat pump. Because of the efficiency of water as a heat transfer medium, a Radiana system can operate at a higher (that is not such a low temperature) temperature than air-only systems. Chilled water supply from the chiller in a radiant cooling system is typically 12°C compared to 4°C for conventional all-air system water. This means that the chiller/heat pump can operate at a higher efficiency leading to reduced overall power consumption.

These two factors combine to deliver significant energy savings. One study¹⁰ commissioned by the California energy commission and run by UC Berkley concluded that when radiant cooling is integrated as part of the overall design of the building an energy reduction of between 31-33% could be realised. In another study⁵ the average potential savings of a radiant cooling system with dehumidification/ventilation was assessed as between 17-42% depending on the climate, building age and design. Energy savings are generally dependent on the design of the building, its location, the local climate and what system it is being compared to.

Radiana can contribute to reduced Refrigerant Gas loss

Many air-conditioning systems use larger amounts of refrigerant gas to circulate around the fan system. Radiana uses reduced amounts of refrigerant gas because it only uses refrigerant gas in the heat pump and does not circulate it within the building. Less gas means lower leakage volumes and therefore reduced contribution to climate change.

Reduction in the heat Island impact of air-conditioning

Increasingly our cities are getting hotter. The urban heat island effect is not a new phenomenon, but countries like the UK are more exposed to the threats of extreme heat as summers get longer and hotter. Temperatures in the London are, on average, one to three degrees Celsius hotter than the surrounding countryside. There are many reasons for the heat island effect however air conditioning heats up the external environment by removing the heat from inside the buildings and pumping it into the external environment. Because Radiana operates the heat pump more efficiently, plus the fact that typically Radiana requires a smaller heat pump, this means that less heat is emitted outside for the same amount of cooling.

The sustainability benefits of Radiana are relevant to the London Plan. From page 195 of the plan there are two areas Radiana can help; Radiana is more energy efficient so generates less heat outside the building and Radiana has a lower operational carbon footprint because of its energy efficiency.

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