

BEHIND THE EFFICIENCY OF SOLUS+



BEHIND THE EFFICIENCY

"With all the advantages and benefits proven by numerous studies in the last 50 years, it can be concluded that radiant heating systems offer the best potential to integrate all the elements required for an optimal indoor environmental quality (IEQ). With the latest relevant technologies and an established scientific background on thermal comfort available, the challenge now is on the development of an adaptive and fast-response radiant (IR) heating system based on an optimal thermal comfort - energy saving control."

- M. N. Alban ¹

Efficiency of heating is a multifaceted subject and whilst many electric heaters are very efficient (nearing 100%) at converting electrical energy into heat energy when brand new, SOLUS is both highly efficient in creating heat, maintaining efficiency throughout its lifetime and also crucially at delivering heat in an efficient way. SOLUS+ is highly effective at delivering heat to where it is needed, ensuring you get maximum comfort in the shortest amount of time, whilst consuming as little energy as possible.

All electric heaters are 100% efficient at converting electricity to heat, however measuring efficiency of heat conversion in this way is not a very useful measure of heating effectiveness. The most important measure of efficiency is how much it costs you to heat and maintain a comfortable temperature in your home.

Unlike conventional electric convection heaters, SOLUS+ relies on infrared heat rather than convection to improve the efficiency of heat delivery. Studies have shown that convection heating requires 1/3rd more energy to be consumed than infrared heating ².

Rather than warming the air around the heater and forming convection currents to move the heat around the room, infrared heating warms the objects in the room directly. This allows SOLUS to directly heat you, rather than the air around you.

Air stores and delivers heat fairly poorly, and the heat from convection radiators, once in the air, rises to the top of the room, not exactly where you want it and limiting the heating ability of the convection heat source ³.

Convective heat is also more susceptible to loss of heat from the room through gaps in windows and doors. Infrared heating instead warms the walls, furniture and even the people in the room gently, which then slowly releases the heat directly into the room offering a gentle ambient warmth that is very comfortable ⁴.

THERMAL COMFORT

Thermal comfort is the most important measurement of a heating system. As humans, our thermal comfort is reliant on a number of factors. Approximately 60% of thermal comfort relies upon the gain, or loss of heat through radiant sources. This is significant when compared to air temperatures, which only affect our feeling of thermal comfort by approximately 15%.

This means that heating comfort is much more dependent on the environment around you than the actual air temperature, which is why on a sunny winter day the comfort difference between direct sun and an area of shade can be quite drastic.

Generally in a home environment, we need the air temperature to be between 16°C and 26°C to prevent it feeling cold. SOLUS+ is designed to warm the walls and ceilings of a room to between 17°C and 22°C. This is the ideal range to ensure our perceptible thermal comfort is maximised.

¹ "LITERATURE STUDY ON RADIANT HEATING IN A THERMALLY-COMFORTABLE INDOOR ENVIRONMENT", September 2010. (http://www.ducoterra.com/wpcontent/uploads/2014/05/summ_report_study_kul_rad_heat.pdf)

² Aristotle University of Thessaloniki "Infrared Heating Comparison with Conventional Heating" 2010 p5

³ Ardehali, MM, Panah, NG, and Smith, TF. 2004. Proof of concept modeling of energy transfer mechanisms for radiant conditioning panels. *Energy Conversion and Management* 45 (2004) : 2005-2017
Dudkiewicz, E. and Jezowiecki, J. 2009. Measured radiant thermal fields in industrial spaces served by high intensity IR. *Energy and Buildings* 41 (2009): 27-35.

⁴ Zmeureanu, R., Fazio, P.P., and Haghighat, F. 1988. Thermal Performance of Radiant Heating Panels. *T ASHRAE* 94(2): 13-27)

Infrared heaters have also been shown to give a similar level of thermal comfort at around 2°C lower air temperature than heaters that heat the air to 21 °C ⁵. Which means that significantly less energy is required.

One other main difference with traditional convective sources is that the vertical temperature differential tends to be lower with infrared heating. With convection heaters, the difference between the temperature on the floor and high up close to the ceiling can be extremely large and studies have shown this can directly affect thermal comfort ⁶. Infrared heating doesn't suffer from large vertical air temperature differences.

COST EFFICIENCY FROM SMART HOME

Smart home integration is a key part of how we and our customers view the future of home heating. There is a practical element to include a smart home integration to home heating. Cost efficiency and the reduction in energy consumption.

PRESENCE SENSING AND EFFECTIVE SCHEDULING

Effective heating scheduling as well as presence sensing can account for up to 24% less energy consumption ⁷. We built our app with easy to use smart scheduling to making sure that your heating preferences matches your lifestyle needs. By including geolocation features in the future release of our app, the heater will be able to also automatically switch off your when you leave home ensuring that your heating is switched off and your energy consumption minimised.

WEATHER PREDICTION/ ADAPTIVE HEATING

Koleda is currently working on an adaptive heating system that corresponds to weather forecasts near your home. Integrating weather forecast optimisation has been estimated to deliver up to 7% savings in your energy bill ⁷.

When we built the SOLUS+ heater, we re-imagined the electric radiator from the ground up. We designed the product so that it can be upgraded with additional smart features ranging from software updates to complementary hardware. In the future we plan on releasing free software upgrades such as open window detection and tailored (learned) heating plans, to ensure we can help you reduce your energy costs.

SAFETY

We're also pleased to announce that we have now received our certifications from TÜV Nord to certify that SOLUS conforms to the EN 60335-2-30 and EN 60335-1 standards for home heaters and home appliances. These certifications ensure SOLUS meets the highest European safety standards. Moreover, the SOLUS+ M1 and M2 heaters have a IP44 rating as issued by TUV Nord, meaning that they are protected from water splashes from all sides. This allows our heater to safely be used in bathrooms and kitchens.

ELECTRIC HEATING

Traditionally electric heating has been seen as a carbon intensive energy source. However, as renewable energy sources increase supply on the grid, and the grid in many countries becomes 'greener', electric heating systems are now falling much more inline with gas in terms of their carbon factor. In response to this, regulations like SAP10 in the UK look to bring electricity in line with gas over the next year or so. For homes with Solar PV systems installed on their roofs, an all electric heating system can allow you to significantly reduce your heating costs, and research has shown that a Solar

5 Dudkiewicz, E. and Jezowiecki, J. 2009. Measured radiant thermal fields in industrial spaces served by high intensity IR. *Energy and Buildings* 41 (2009): 27-35.

6 Tannan, M. Human Thermoregulatory Response to Infrared Radiant Heating. (https://www.ceramicx.com/documents/Human_Comfort_Heating_Research.pdf)

7 Kersken, M & Sinnesbichler, H. 2013. Simulation study on the energy saving potential of a heating control system featuring presence detection and weather forecasting. *IBP REPORT 40, NEW RESEARCH RESULTS IN BRIEF.*

PV system with Infrared has the lowest lifetime cost of any heating type ⁸.

LOT 20 COMPLIANT

Our heaters also comply with the more recent EU Lot 20 Legislation. In 2018 Lot 20 was bought in to decrease the electricity consumption from electrical heating appliances by asserting more control in how they are operated. As a result the SOLUS+ has features such as scheduling, eco mode and a thermostat with accuracy up to 0.5 of a degree. However, we have gone beyond the basic requirement of Lot 20 to create smart modes that make managing your heater easier and more transparent than ever before ⁹.

FURTHER READING

Below is a list of other important references relating to the heating efficiency and delivery characteristics of infrared heating.

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Kalisperis, L.N., Steinman, M., Summers, L.H., and Olesen, B. 1990. *Automated design of radiant heating systems based on MRT*. T ASHRAE 96(1): 1288-1295

Ling, M.D.F. and Deffenbaugh, J.M. 1990. *Design strategies for low temperature radiant heating systems based on thermal comfort criteria*. T ASHRAE 96(1): 1296-1305

Roth, K., Dieckmann, J., and Brodrick, J. 2007. *Infrared radiant heaters*. ASHRAE Journal 49 (6): 72-73

⁸ Aristotle University of Thessaloniki. *Infrared Heating Comparison with Conventional Heating*. 2010 p5

⁹ <https://www.lot20.co.uk/sites/default/files/LOT%2020%20document.pdf>