Verification of Low Voltage Technology Costs for WarmTronics Heat Mat

16th September 2024

Contents

1. Introduction
2. Methodology
3. Results
4. Conclusion

Dr Sam Hu

Impact Fellow

Green Futures Solutions

University of Exeter

Exeter, Devon

Introduction

This study was commissioned by WarmTronics to verify a low voltage heat mat with anti-fatigue comfort rubber. The heat mat weighs 18.7 kg with dimensions of 905mm x 690mm x 27mm. At the temperature of 60°C, the heat mat employs a cycling mechanism to reduce energy consumption. It maintains a low wattage for a short duration before switching to a high wattage. This cycle repeats as long as the temperature is kept at 60°C.

Methodology

The heat mat underwent a rigorous 24-hour testing period from 11 AM on Wednesday, September 11th, to 11 AM on Thursday, September 12th, at the Solar Energy Laboratory in the Environment and Sustainability Institute located on the Penryn campus (Cornwall) of the University of Exeter. This testing evaluated electrical usage and performance stability during sustained operation.

Powered by a WarmTronics Power Supply (AC 230-240V at 50/60 Hz input, AC 48V at 50/60 Hz output, 400W power capacity), the device was assessed for potential risks associated with continuous electrical operation in the context of IV (current-voltage) testing and thermal conductivity measurement.

The experiment was conducted under the oversight of Dr Sam Hu and Dr Anurag Roy. Sam is an Impact Fellow at Green Futures Solutions and the principal investigator for this project. Anurag is a postdoctoral research fellow in the Solar Energy Research Group, who supports Sam conducting the testing in the Solar lab. Their expertise ensured adherence to safety protocols and accurate data collection. Both electricity and temperature readings are recorded.

For more information on the tested heat mat and its specifications, please visit the Warmtronics website: https://www.warmtronics.com/products/standard-heat-mat/.

Results

During the 24-hour testing session, electricity intake remained consistent and linear, as illustrated in Figure 1. The heat mat consumed a total of 4.942 kilowatt-hours (kWh) over this period, averaging 206 watts per hour. Detailed data for electricity and temperature readings are available in the supplemental materials, "WarmTronics 24hr Testing Electricity Readings" and "WarmTronics 24hr Testing Temperature Readings."

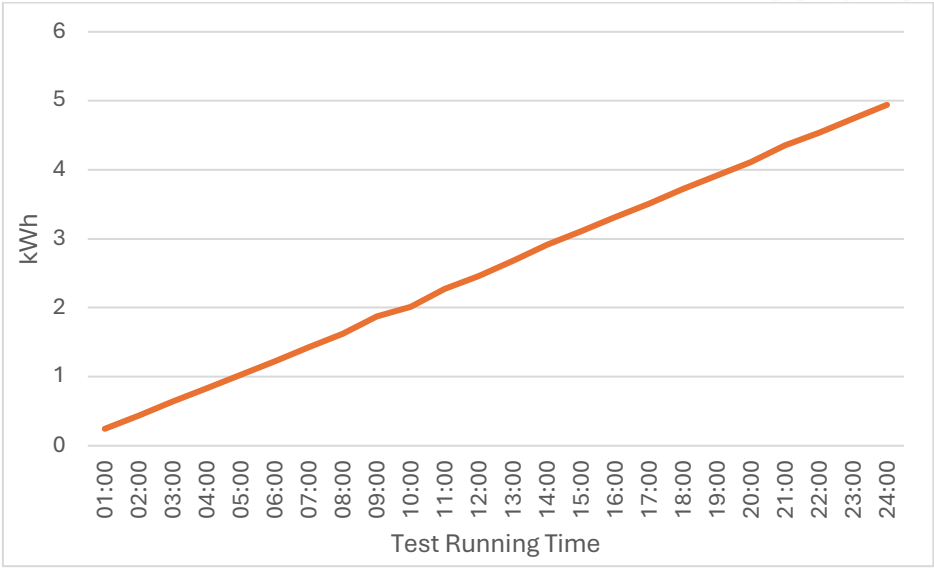

Figure 1. Electricity Readings Over Time

In a subsequent experiment, we first allowed the temperature to drop to approximately 30°C (room temperature) before setting the heat mat to its maximum power to achieve a temperature of 60°C. As illustrated in Figure 2, electricity consumption ranged between 333 and 337 watts during the heating phase, which took 17 minutes. Once the desired temperature 60°C was reached, the heat mat entered a cycling mode: electricity input decreased to 13.5 watts for approximately 1 minute and 14 seconds before returning to a high wattage of 334 watts for roughly 2 minutes and 20 seconds. The cycling mechanism continued to operate as long as the heat mat's temperature remained at 60°C. If the temperature dropped below 60°C, the cycling mode would cease. Detailed data for electricity and temperature reading are provided in supplemental materials – 'WarmTronics Cycle Testing Electricity Readings' and 'WarmTronics Cycle Testing Temperature Readings'.

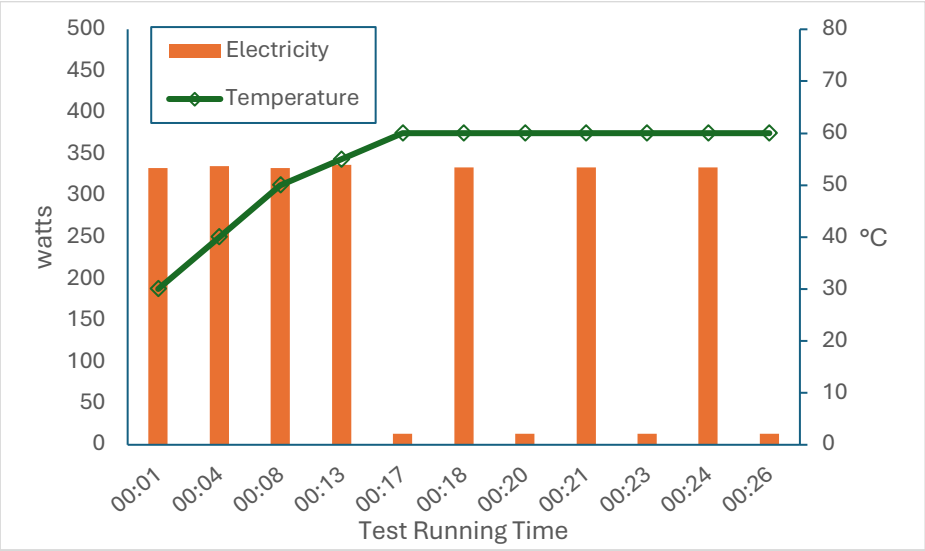

Figure 2. Electricity and Temperature Readings Since the Test Started

Conclusion

The findings indicate that the tested WarmTronics heat mat can reduce energy consumption by cycling between a low wattage for a short period and a high wattage when the temperature of the mat reaches 60°C.

This translates to an estimated energy cost of approximately £0.51 per day, calculated as follows:

$$£0.30 * (0.336 * 0.5 + 0.206 * 7.5) = £0.51$$

This calculation assumes the heat mat operates for 8 hours daily and the electricity rate is £0.30 per kWh. During the 8-hour operational period, we estimate that the electricity usage is 0.336 kWh for the initial half hour before the heat mat reaches 60°C. Subsequently, the cycling mechanism triggers, and electricity usage drops to 0.206 kWh for the remaining seven and a half hours.

The estimated energy cost of £0.51 per day is based on specific assumptions regarding the heat mat's usage and electricity rates. Actual costs may vary depending on factors such as individual usage patterns, regional electricity prices, and changes in the heat mat's performance.