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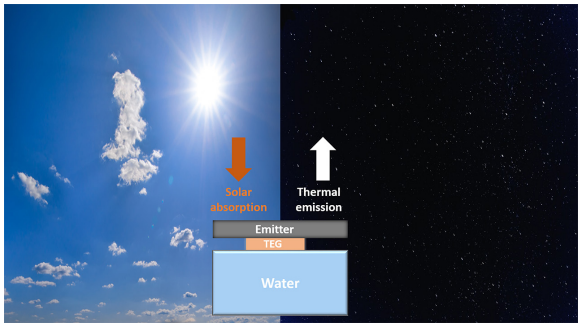
Combining heat exchange with space and heat storage in water to advance nighttime power generation goals.



Solar energy technology has come a long way in the last few decades, and plays an enormous role in facilitating the urgent transition to clean energy. But there are still areas for improvement, including energy generation at night, which currently relies on costly and hazardous batteries.

Using water-based heat storage and radiative thermal emitters across thermometric devices, Alajlan et al. recently demonstrated a new approach for continuous energy harvesting that achieved a peak power density far surpassing results from previous experimental records.

“We developed a technique that can generate electricity during an entire 24-hour period by exchanging heat with the outer space,” said author Abdulrahman Alajlan. “The key element of our system is the compact water tank that works as a thermal storage for accumulated heat from sunlight.”

The technique also features a thermoelectric generator, a solid-state device, that helps convert excess heat into electricity. The nighttime power generation was shown to reach up to 32 milliwatts — enough to power an LED light without any additional electricity source.

“One of the amazing features of this system is that it can maintain the same performance level despite seasonal and weather variation,” said Alajlan. “This work opens new opportunities for utilizing waste-heat energy as an alternative green technology.”

The findings add to an important and growing body of work aimed at advancing large-scale nighttime power generation. Collectively, the work represents enormous potential for a range of applications, such as highway lighting systems and wireless sensors in off-grid locations.

Source: “All-day thermoelectric power generation beyond 1 Wm^{-2} regime via radiative heat exchange with space and water-based heat storage,” by Abdulrahman M. Alajlan, Abdurrahman A. Almethen, and Hussam Qassem, *Applied Physics Letters* (2022). The article can be accessed at http://doi.org/10.1063/5.0099708.

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