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Radiative Cooling & Electricity Generation

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Recently, a scientist of Indian-origin has demonstrated a new way to **generate electricity at night**, without any active heat input.

- The prototype device employs **radiative cooling**, in which a sky-facing surface passes its heat to the **atmosphere as thermal radiation, losing some heat** to space and reaching a cooler temperature than the surrounding air.
 - This phenomenon explains how frost forms on the grass during above-freezing nights, and the same principle can be used to generate electricity, **harnessing temperature differences to produce renewable electricity at night**, when lighting demand peaks.
- According to the **laws of thermodynamics**, everything on Earth emits heat.
 - At night, when one side of Earth turns away from the sun, its buildings & streets cool off.
 - If no clouds are present to trap warmth, objects on the Earth can lose so much heat that they reach a lower temperature than the air surrounding them.
- It can be noted that humans have taken advantage of this effect for millenniums. Six thousand years ago, people in Iran and Afghanistan constructed enormous **beehive-shaped structures** called **Yakhchal**, which used this **passive cooling** effect to **create and store ice in the desert**.

Working Principle

- This device releases the heat unevenly in a manner that the top side cooling is more than the bottom side cooling. It then **converts the difference in heat into electricity**.
- At its heart is the gadget called a **thermoelectric generator**, which uses the difference in temperature between opposite sides of the device to generate a current.
- When the device was connected to a voltage converter, it was able to power a white LED.


Potential Application

- This could be a broadly enabling approach to power generation suitable for remote locations, and anywhere where power generation at night is needed.
- While solar cells are an efficient source of renewable energy during the day, there is currently no similar renewable approach to generating power at night.

Way Forward

- Although the amount of electricity it generates per unit area remains relatively small, limiting its widespread applications for now, but the researchers predict it can be made twenty times more powerful with improved engineering -- such as by suppressing heat gain in the radiative cooling component to increase heat-exchange efficiency.
- If this device could produce any amount of electricity at night, it would be valuable as after the sun sets, solar cells don't work and winds often die down. This innovation is vital in complementing other renewable sources of energy.

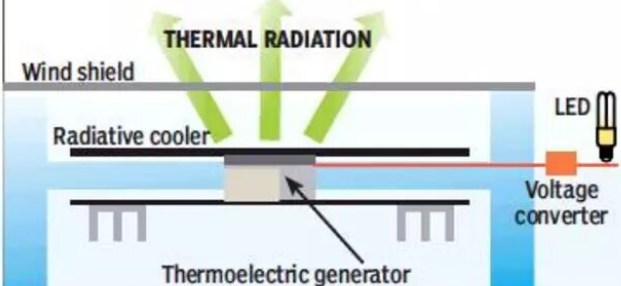
POWERED BY TEMPERATURE CHANGE



Aaswath Raman's device employs radiative cooling, a phenomenon that makes buildings and parks feel cooler than the surrounding air after sunset. His prototype uses a polystyrene disk coated in black paint and covered with a wind shield. At its heart is a thermoelectric generator


How the device works

- As the device releases heat, it does so unevenly, the top side cooling more than the bottom
- Thermoelectric generator at the centre of the device uses the difference in temperature between opposite sides of the device to generate a current



The diagram illustrates the device's components and operation. A wind shield is positioned above a radiative cooler. Green arrows labeled 'THERMAL RADIATION' point upwards from the radiative cooler. Below the radiative cooler is a thermoelectric generator, which is connected to a voltage converter and an LED light. The entire device is shown in a cross-section view.

Its underlying method's been used for millennia



Humans have taken advantage of this effect for millennia. Six thousand years ago, people constructed enormous beehive-shaped structures called **yakhchal** to create and store ice in the desert

Source: Economic Times