Solar power

Rain or shine: new solar cell captures energy from raindrops

New device is designed to prevent power output plummeting when the sun isn't shining – but practical application is still some years off

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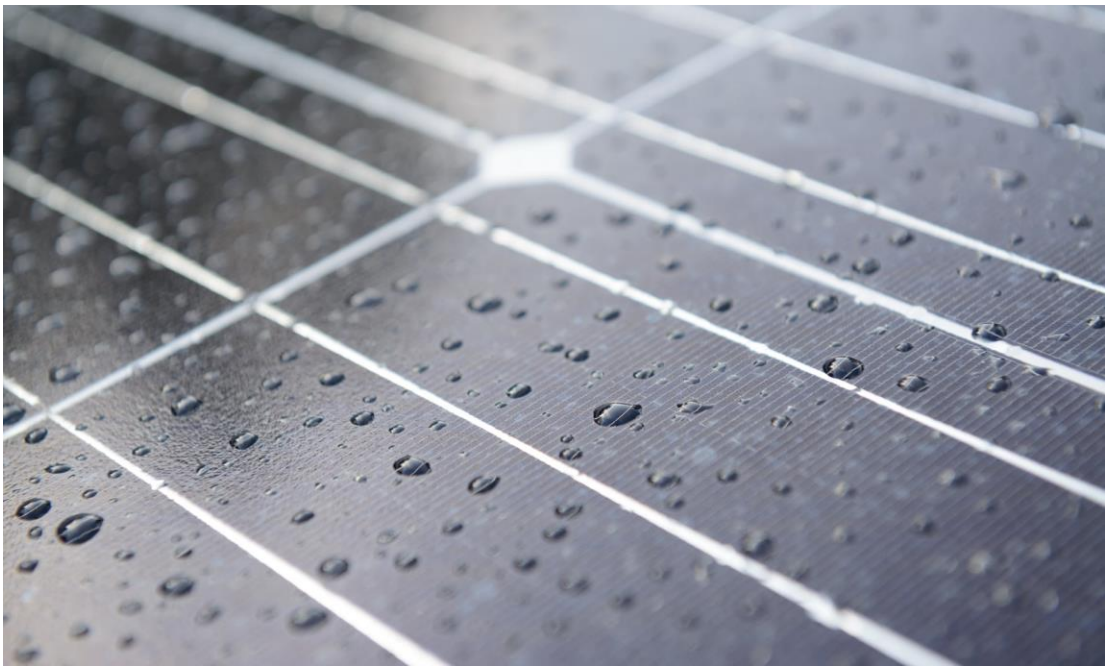


Researchers want to create a hybrid device that harvests kinetic energy from water as well as solar power from the sun. Photograph: Getty Images

A solar panel that can generate electricity from falling raindrops has been invented, enabling power to flow even when skies cloud over or the sun has set.

Solar power installation is soaring globally thanks to costs plunging 90% in the past decade, making it the cheapest electricity in many parts of the world. But the power output can plummet under grey skies and researchers are working to squeeze even more electricity from panels.

The new device, demonstrated in a laboratory at Soochow University in China, places two transparent polymer layers on top of a solar photovoltaic (PV) cell. When raindrops fall on to the layers and then roll off, the friction generates a static electricity charge.

“Our device can always generate electricity in any daytime weather,” said Baoquan Sun, at Soochow University. “In addition, this device even provides electricity at night if there is rain.”

Other researchers have recently created similar devices on solar panels, known as triboelectric nanogenerators (Tengs), but the new design is significantly simpler and more efficient as one of the polymer layers acts as the electrode for both the Teng and the solar cell.

“Due to our unique device design, it becomes a lightweight device,” said Sun, whose team’s work is published in the journal ACS Nano. “In future, we are exploring integrating these into mobile and flexible devices, such as electronic clothes. However, the output power efficiency needs to be further improved before practical application.”

Sun said the field was developing fast and expects to produce a prototype product in three to five years. Other scientists in China have also used Tengs on solar cells to harvest some power from the wind, an approach Sun said could be added to his device. The top layer of the Teng is also grooved to help focus more light on the solar cell.

“The idea is interesting – a hybrid device that harvests kinetic energy from water without destroying the output of the solar cell during sunny times,” said Varun Sivaram, at the Council on Foreign Relations, US, and author of a new book on solar power. “There’s lots of nice engineering, like using one layer to do double duty as a component of the Teng as well as trap light for the solar cell.”

However, Varun said the power the device generates from falling rain needs to be significantly higher to start making an overall difference to a solar panel’s output. “It’s really not clear whether this is a big deal or not – I suspect it’s not.”

Prof Keith Barnham, at Imperial College London, said the hybrid device gave an important advantage in making it more compact and efficient. But he said: “Wind power is clearly the most effective and complementary power source to PV – and it works equally well in the rain!”

Other innovations in solar panel design include using the mineral perovskite as a flexible and efficient material, using so-called “quantum dots” and researching artificial photosynthesis, which uses sunlight to produce liquid and gas fuels.

Topics

Solar power /Renewable energy/ Energy news

Solar panel makes light of a sudden downpour

Oliver Moody, Science Correspondent

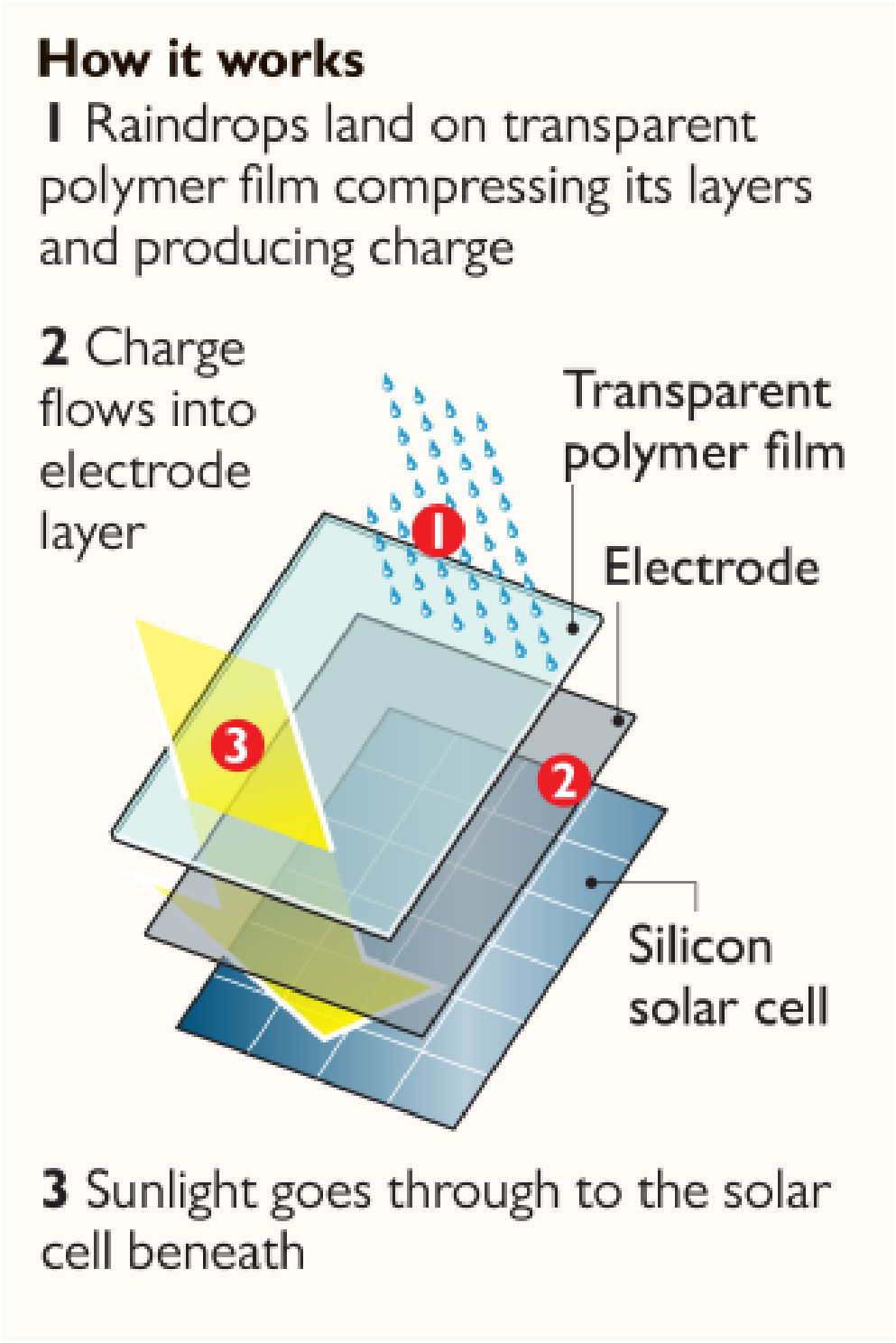
March 15 2018, 12:01am, The Times

On sunny days Britain can produce more than 8GW of solar energy, but on dull days during the winter months this can fall well below 1GW
CHANDAN KHANNA/AFP/GETTY

Solar panels are all very well, but what Britain really needs is a rain panel.

While on sunny days the UK can produce more than 8GW of solar energy, enough to meet almost a quarter of its demands,

rays to capturing the mechanical energy from falling raindrops.



They say that the technology could be incorporated into electricity-generating raincoats that power the wearer's gadgets

rain to a triboelectric nanogenerator (Teng), which converts the downwards force exerted by the rain into electricity.

The physics is fairly straightforward. The ancient Greeks noticed that when some materials, such as fur and amber, were rubbed together, the contact appeared to result in a charge. We know today that this is because electrons are transferred from one material to the other, leaving a net negative charge on one surface and a net positive charge on the other.

The Teng channels this charge into an electrode through electrostatic induction. Zhen Wen and his colleagues at Soochow University in Jiangsu province are not the first to use Tengs to glean energy from the rain. Their innovation was to hook the solar cell up to a transparent Teng through a shared electrode. When raindrops fall on the panel, they compress the Teng, generating an electric current that flows through the electrode.

This design also uses the Teng to protect the solar cell. Its chief limitation is that the rain and sun functions cannot operate at the same time. “We are now designing a fibre-shaped device and expect to weave them together as a fabric,” Dr Zhen told the website Phys.org. “My wish is to fabricate clothing that can generate electricity from sunshine and raindrops.”

RENEWABLE ENERGY

Come rain or shine

ACS Nano **12**, 2893–2899 (2018)

Credit: Ken Welsh / Alamy Stock Photo

Solar cells suffer from reduced performance on cloudy days, leading to intermittent energy supply in all but the sunniest of locations. This poses a challenge to the expansion of the solar sector. To improve power generation in cloudy areas there have been attempts to integrate solar cells with triboelectric nanogenerators (TENGs) that harvest power from raindrops. Integration has proved difficult in practice, however, because the TENG device — which sits above the solar cell — intercepts sunlight, reducing solar cell performance to an unacceptable degree.

Yuqiang Liu and Na Sun from Soochow University, China, and colleagues solved this problem by using a mutual function electrode film layer for the solar and TENG components. This integrated system is able to convert solar and raindrop energy into electrical power without significant antagonism between the two components, combining the advantages of the high current output level of the solar cell and the high voltage output level of the TENG. This innovation provides a means to collect energy from the environment under different weather conditions and may in due course find application in wet regions that are less suited to conventional solar arrays. *AB*

https://doi.org/10.1038/s41558-018-0165-2

NATURAL DISASTERS

Unequal exposure

Environ. Dev. Econ. http://doi.org/cm9p (2018)

Credit: Dinodia Photos / Alamy Stock Photo

The frequency, intensity and spatial distribution of natural disasters, including floods and droughts, are expected to change in the future due to climate change. Understanding the vulnerability of poor people to natural disasters in both the present and future is crucial to managing this risk.

Hessel Winsemius from Deltares and Vrije University Amsterdam, The Netherlands, and colleagues provide a new global assessment of the extent to which poor people are disproportionately exposed to river floods and droughts. The authors construct a poverty exposure bias measure — the fraction of poor people exposed to floods and droughts compared to the fraction of all people exposed in a country — by combining georeferenced household survey data with hydrological riverine flood and drought maps for 52 countries. Historically, they find that in most countries, poor people are overexposed to droughts and urban floods, but not rural floods. Under a high-emissions climate change scenario, they find that overall future exposure increases, but there is no change in the exposure bias.

Data limitations make local-level disparities difficult to capture, but the current findings advocate for more attention to income-sensitive disaster risk management. *AY*

https://doi.org/10.1038/s41558-018-0166-1

CRYOSPHERIC SCIENCE

Disappearing Andean snow

Cryosphere http://doi.org/cm9q (2018)

Snow melt in the Andes is critical for water supply across Argentina, Bolivia, Chile and Peru, motivating analyses of snowpack variability for the development of water management strategies, particularly in light of anthropogenic climate warming. However, understanding of snowpack changes has been hampered by a sparse observational network. Freddy Saavedra from the Universidad de Playa Ancha, Chile, and colleagues use remote sensing data to investigate changes in mountain snowline elevation and snow persistence across a large swathe of the Andes (8–36° S) between 2000 and 2016.

It is found that regions south of 29° S have seen 2–5 fewer days of snow cover per year, raising the snowline by 10–30 m annually. These changes are largest in the winter seasonal snow zone, particularly in the eastern Andes, and are attributed to reductions in annual mean precipitation and increasing temperatures. North of 29° S, however, snow modifications are minimal, primarily due to low climatological coverage. Further work is required to determine whether such short-term perturbations reflect long-term trends, but the results illustrate the need for continued snow monitoring to inform future water planning. *GS*

https://doi.org/10.1038/s41558-018-0168-z

MARINE CARBON CYCLE

Taking a closer look

Glob. Biogeochem. Cycles http://doi.org/cm9r (2018)

Carbon export in the ocean is linked to plankton productivity in the surface waters, yet ocean models are typically run at too coarse a resolution to capture mesoscale (10–100 km) ocean circulation. Circulation at this scale influences nutrient transport and plankton, so estimates from lower-resolution simulations may not accurately capture export production.

To address this issue, Cheryl Harrison of the National Center for Atmospheric Research and the University of Colorado, Boulder, USA, and co-authors use simulations at different resolutions, eddy-resolving (0.1°) and non-eddy-resolving (1°), in the Community Earth system Model. They find that the higher-resolution simulation shows a small (<2%) decrease when considering global export production, however at local scales there is a large ±50% variation due to regional effects.

In areas where off-shelf transport of nutrients drives productivity, improved representation of coastal jets, which block this transport, and turbulence results in lower export. In contrast, export is increased in the subantarctic due to a deeper and narrower mixed layer, capturing more nutrients that fuel higher production. These large regional differences that result from mesoscale circulation should be considered when calculating carbon export and budgets. *BW*

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