

# More Power from the Sun

## 39 Ways to Save the Planet

### Richard of York

Richard Of York Gave Battle In Vain. What does this lyric help you with?



Figure 1 © Yingchih

### Solar power

Solar power is quite simply light energy produced by the sun; it is a renewable energy. It is lauded as an inexhaustible fuel source and was first used as far back as 1954 at Bell Labs New Jersey when an illuminated solar battery was designed to supply electricity.

Figure 2 shows a traditional silicon crystal solar panel. A solar panel is made from a semi-conductor which absorbs sunlight i.e., photons. Photons are absorbed, hit into electrons, and produce kinetic energy. Electrons carry the current and move around the semi-conductor which is surrounded by electrodes — allowing the electrons to flow out of the panel, into an electric circuit and out into the National Grid. In the past most solar panels were constructed with silica, which only absorbs red light, and excess blue light is lost as heat. Go to the [BBC Bitesize webpage](#) to learn more about the basic definition.



Figure 2 a solar power field © Zbynek Burival

There is now a new material and a new way of putting together photovoltaic panels. In 2009 an experiment using perovskite allowed scientists to create a new solar panel design in a much more inexpensive way. Less is wasted and you get more clean, green energy production. Perovskite materials have the potential to lead us up to 40% efficiency over the next decade when mixed with silica (currently industrially produced solar modules only achieve 22% efficiency). If we were to use these standard silicone solar cells with roughly 20% efficiency it is estimated that we would lower our greenhouse gas emissions by 12% by 2050. Using perovskite would increase this to 18%.

Perovskite was discovered in the Ural Mountains in 1839 but it has only very recently been recognised as a valuable, viable mineral in solar power. It is now used in solar panels around the world. Figure 3 shows engineers installing all-organic, perovskite quantum dot solar panels.



Figure 3 workers with solutions of all-inorganic perovskite quantum dots © Science in HD

### **Oxford PV**

Oxford PV are a world leading solar panel company who are leaders in perovskite photovoltaic technology. Perovskite is a mineral with a common crystal structure and is the most abundant mineral on the planet! Silica perovskites  $MgSiO_3$  are the most common in the mantle (there are other variants). Due to such a high density of  $MgSiO_3$  a boundary is created, which geographers learn in Plate Tectonics is the mantle 'transition zone'.

Beyond this zone perovskites are crushed into a new mineral called Post-perovskite. This mineral has a high conductivity. Scientists recently discovered perovskite can also create a charge when light is shone on it, effectively producing a miniature solar cell (Figure 4). Because this mineral has a remarkably higher level of conductivity metal halide perovskites are now being used in a newly designed solar panel by Oxford PV.

Conventional silicone crystal panels remain the most common type of solar energy panels however this is expected to change as a mainstream panel will only produce 320W of energy whilst the new Oxford PV perovskite panels, which can produce up to 440W, are a more productive second-generation design.

The perovskite-coated panels are black and produce more energy per  $m^2$ . This means they will be more aesthetically pleasing (silicon panels have a blue tint) and they will be perfect for 'constrained spaces' such as rooftops.

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The breakthrough in solar power is being hailed as ‘a true change’ for solar technology by Dr Chris Case, chief technology officer at Oxford PV. The industry has not changed much at all in fact since silicon-based solar panels were first developed in the 1950s.

1. Oxford PV is an industry leader, but the UK is not one of the top generators of solar power worldwide. Go to the [Our World in Data Renewable Energy page](#) and click ‘Solar energy generation’ in the banner on the left of your screen. By the millennium, which sole country was the only nation-state to achieve more than 1TWh of energy from solar power?
2. Watch this interactive map all the way through to 2019. Which European country has invested the most in solar energy (ever since their Renewable Energy Act of 2000)?
3. There is a difference between energy *generation* and maximum *capacity*. Now look at the next interactive map for ‘Installed solar capacity’. Change the view to Table (using the tab underneath the graph). Which country has the highest absolute change in capacity from 1965 to 2019?
4. Oxford PV will hope to sell their perovskite-coated panels in countries with both proven solar power generation and high installed solar capacity. Analyse this [solar energy generation vs. capacity comparison graph](#), which countries might be future targeted markets?

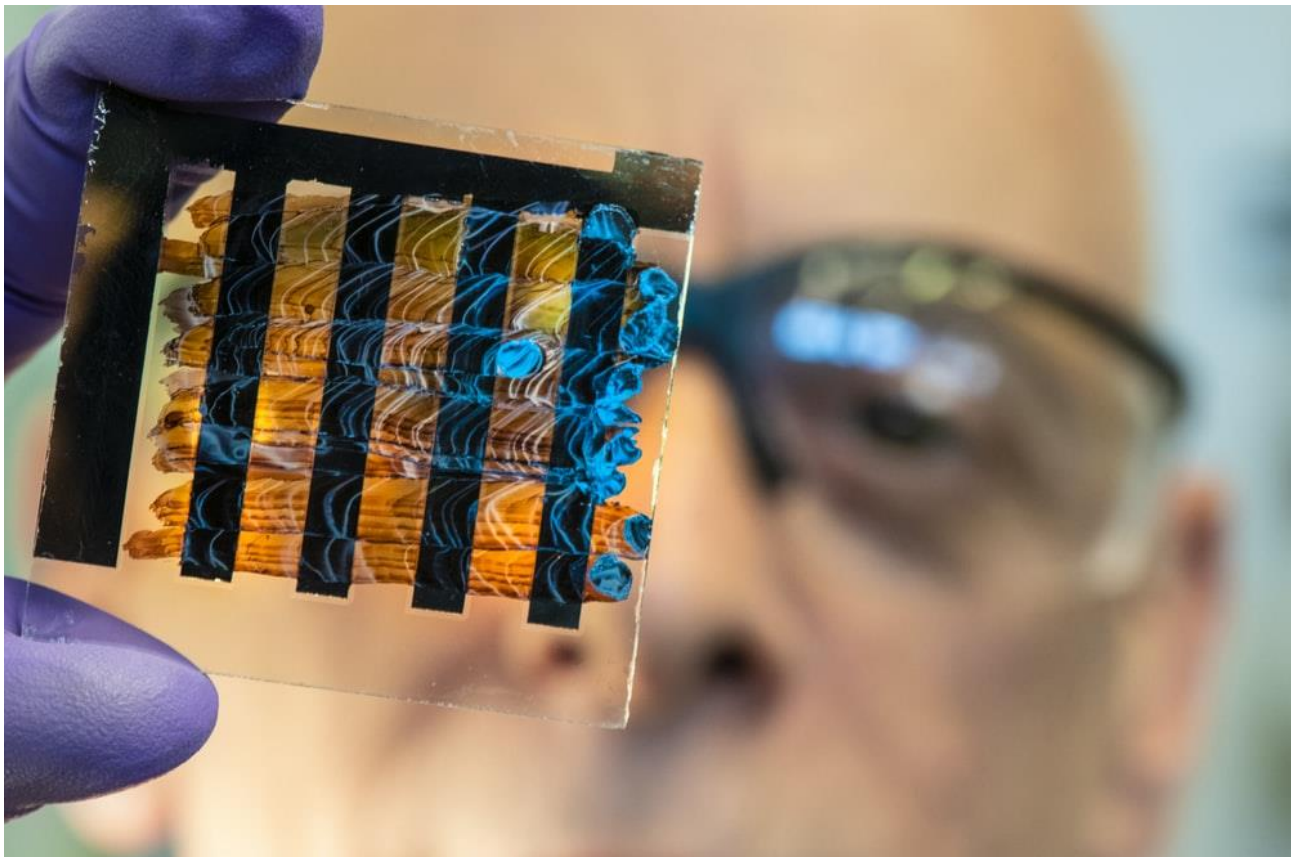


Figure 4 a perovskite solar cell © Science in HD

### Further reading

- What is solar power? <https://www.nationalgeographic.com/environment/global-warming/solar-power/>



- How governments spurred the rise of solar power <https://www.economist.com/technology-quarterly/2021/01/07/how-governments-spurred-the-rise-of-solar-power>
- Everything you ever wanted to know about perovskites from the Science Magazine <https://www.youtube.com/watch?v=5oZWLKSDVBk>
- UK firm's solar power breakthrough could make the world's most efficient panels by 2021 <https://www.theguardian.com/business/2020/aug/15/uk-firms-solar-power-breakthrough-could-make-worlds-most-efficient-panels-by-2021>
- Solar power in Germany <https://www.cleanenergywire.org/factsheets/solar-power-germany-output-business-perspectives>

### Suggested questions for More Power from the Sun

- a. What is the 'spectrum problem'?
- b. What does the International Energy Agency say about solar power energy?
- c. What is the practical 'ceiling' for solar panel efficiency?

### Answers

1. **The U.S.**
2. **Germany has one of the highest solar outputs in the world, with an installed capacity of 49 gigawatts (GW) as of 2019 ranking Germany the 4<sup>th</sup> by IRENA in the world for their renewable energy power capacity.**
3. **China has the highest absolute change in capacity from 1965 to 2019, with a value of +223.80 TWh.**
4. **The top 5 countries with both high solar energy generation (GWh) and high installed solar capacity (GW) are: China, Japan, U.S., Germany and India.**

### An RGS-IBG expert

Go to [What our expert says](#) to hear further analysis from Professor Stephen Peake on the potential of perovskite solar panels in *39 Ways to Save the Planet*.

