**Almost five years ago I brought you a video explaining how a startup company called Lightsource had developed a very smart piece of technology that enabled it to effectively deliver power from a solar farm to the grid right through the night, without resorting to expensive battery storage. Sounds highly unfeasible, doesn’t it? And, it was a bit of a workaround in all honesty. They were actually using the INVERTERS that are an integral part of solar farms to harness incoming energy from the grid and kind of reflect it back at a slightly different level to provide what the tech bods call a ‘Reactive power voltage support service’.**

**So, the power WAS technically COMING FROM a solar farm, but it wasn’t really using energy from the sun. Because of course that would be impossible when it’s dark, right?**

**Well, you say that… but a team of clever boffins at the University of New South Wales in Australia beg to differ.**

**They’ve just published some brand-new research highlighting a technology that really does capture photons of light from the sun during the nighttime to produce an electrical current.**

**So, how the bloody hell did they do that then?**

**Hello and welcome to just have a think**

**Well, this one looks completely counter-intuitive at first glance, doesn’t it? Well, it did to me anyway.**

**So, what’s going on here? Is it a genuine breakthrough or just some more jiggery-pokery that only works in a laboratory and proves to be useless out in the real world. Well, let’s work through the detail to see if we can answer precisely that question.**

**We’ll start with a quick reminder of the basic principles of a typical solar photovoltaic or PV panel.**

**When sunlight hits the surface of a solar cell, it arrives as photons of various wavelengths or frequency. Photons with shorter wavelengths at the blue and violet end of the spectrum carry more energy, and photons with longer wavelengths towards the red end of the spectrum carry less energy. A typical solar cell has a layer of silicon which is where all the action happens. At the atomic level, we can think of it as having a sort of structure of bands. They don’t actually look like the physical bands I’m showing you here, but this is the easiest way to illustrate what I’m talking about, so if you’re a particle physicist, please forgive me. Anyway, we’ve got something called a Valence band, where electrons are happily bound to atoms. Then we’ve a conduction ban at a higher energy level, where electrons have escaped their atomic orbits and are free to move around. In between those two bands we’ve got a so-called band gap. For a photon to knock an electron out of the Valence band and into the conduction band it has to have enough energy to allow the electron to bridge that gap, so to speak, which in silicon happens to be about 1.1 electron volts. We don’t really need to worry about the technicalities of what electron volts are here, we just need to know that photons with less energy, towards the infra-red end of the spectrum, pass through the silicon without being absorbed, and photons with too much energy, towards the ultraviolet end, WILL excite electrons, but will also dissipate all their excess energy as heat, which reduces the efficiency of the cell. Photons with the right amount of energy use most or all of THEIR energy to excite electrons from the valence band to the conduction band at optimum efficiency. And when that happens, it leaves a hole in the valence band where the electron used to be. And because electrons are negatively charged, the hole effectively now acts as a positive charge carrier. It’s a process called an electron-hole pair. It gets even more complicated with a so-called positively doped silicon layer that has lots of holes and a negatively doped layer that has lots of electrons, but essentially the important principle is that we’ve got a negative side and a positive side, and we can use that to make an electrical current flow out and do some useful work.**

**We did a deeper dive on the whole Solar PV process in a video a couple of years back, and I’ve left a link to that one in the description section as well if you want to jump back and have a look.**

**So, what earth-shattering insight have our friends down under come up with then? Well, as I’m sure most of you learned folks already know, the surface of our planet heats up during the day, as sunlight hits it, and then gives that energy back to the atmosphere and ultimately to space as infra-red radiation, mostly during the night. And that’s a good thing of course, because if that nighttime release didn’t happen then our planet would have fried billions of years ago, and we wouldn’t be here now. Those of you with a keen interest in climate change, which I hope is all of you, will most likely also know that our current warming predicament is caused by greenhouse gases in our atmosphere that have just the right molecular configuration to capture those infra-red photons and prevent them escaping back out into space. And that’s very definitely a bad thing.**

**But I’ve covered that in dozens of previous videos, and it’s not the focus of this one. I’m sure you’re way ahead of me already actually…yes, you’ve guessed it, the folks at New South Wales Uni have indeed produced electricity from heat radiated as infrared light.**

**Here’s an image that the team took of the Sydney Opera House at nighttime showing how infra-red heat is radiating out. It’s actually the red, yellow AND white regions.**

**Capturing that heat is easier said than done though of course. In fact, until relatively recently it wasn’t considered an option at all.**

**The Aussie team originally achieved that feat a couple of years back and published their results in this paper. They did it using a semiconductor device called a thermoradiative diode, made from the same materials that you can find in night-vision goggles.**

**The paper explains how a thermoradiative diode represents a symmetrical counterpart to a solar photovoltaic cell. Instead of harnessing absorbed light to generate a current, it generates electrical flow by utilizing the net emission of light from a relatively warm region to a relatively cold region. To give you the sciency speak, the team measured the electro-optical characteristics of Mercury Cadmium Telluride photodiodes across a range of bandgap energies in both thermoradiative and photovoltaic operation.**

**In an interview with the Australian Broadcaster ABC, the study’s co-author, Phoebe Pearce, explained it like this.**

 **“In the same way that a solar cell can generate electricity by absorbing sunlight emitted from a very hot sun, the thermoradiative diode generates electricity by emitting infrared light into a colder environment. In both cases the temperature difference is what lets us generate electricity,”**

**Now, our question right at the start of the video was… “Is it a genuine breakthrough or just some more jiggery-pokery that only works in a laboratory and proves to be useless out in the real world?”**

**So, here’s your caveat. And I have to say it’s a fairly major one at this stage. The prototype device in its current iteration is the size of an entire laboratory at UNSW and the amount of power it produces is…a hundred thousand times less than a standard solar panel, but NO DON’T SWITCH OFF…stick with me here.**

**While the team does concede that that’s a little on the low side. It is, according to the research lead, Professor Ned Ekins-Daukes, nevertheless an**

 **‘unambiguous demonstration of electrical power’.**

**The research paper explains that**

 **“at a temperature differential of only twelve and a half degrees Celsius we measured a peak thermoradiative electrical power density of two-point-two-six milliwatts per square metre with an estimated radiative efficiency of one-point-eight percent. Our results highlight the need for achieving high radiative efficiencies with mid-infrared semiconductors to deliver on the promise of thermoradiative power generation.”**

**So, you won’t be running your whole house on this stuff, that’s for sure. But once it’s fully developed and, you know, not the size of a laboratory, the team reckon it could potentially serve as an additional supply that would be enough to run your home Wi-Fi for example or,**

**potentially much more usefully, it could generate enough electricity from your own body heat to run a wristwatch or other small devices that currently rely on costly and relatively heavy batteries. And when you multiply those tiny amounts of energy up into billions of small devices then it starts to get a bit more interesting and worthwhile, don’t you think?**

**And that’s not the limit of the New South Wales team’s ambition either.**

**The news in that September twenty-twenty-four ABC article is that they reckon it could play a really useful role way up above our planet for space craft and satellites.**

**Why? Well because in low Earth orbit where the International Space Station hurtles around our planet at roughly seventeen and a half thousand miles an hour, each day lasts 90 minutes, split into a forty-five-minute period of daylight and a forty-five-minute period of darkness. Sophisticated, and very expensive solar panels provide the power during the light period, but batteries are required when the sun goes out of sight. So, the team is currently focussed on applying their technology to generate power from infra-red radiation during those eclipse periods. And according to Professor Ekins-Daukes, they’re aiming to have a thermo-radiative diode small enough and practical enough to test in space within a couple of years.**

**Now, if you clicked on this video to find out how to power your home WITHOUT batteries or fossil fuels 24-7 and realise your dream of a totally off-grid lifestyle, then yeah, sorry about that. Feel free to tell me what a bozo I am in the comments section below. It won’t be the first time, believe me, and you might need to form an orderly queue.**

**But look, my point here, as is so often the case with my videos, is that we’re not chasing after one single silver bullet that can solve every energy problem we face. That silver bullet just doesn’t exist. What we need is a whole range of different solutions that utilise the freely available energy that surrounds us to address the myriad different challenges in all sorts of different sectors in all sorts of different ways.**

**And in that spirit, I reckon this one was well worth taking a look at.**

**Anyway, like I say, the comments section is down there waiting for you, so now’s the time to jump down there and leave your thoughts, and I promise I’ll do my best to read and respond to as many of them as possible.**

**That’s it for this week, though. As always, a massive thank you to the amazing folks who support my work via the Patreon platform, and enable me to keep ads and sponsorship messages out of all my videos. And an extra special shout out to the folks whose names are scrolling up the screen beside me here, all of whom celebrated an anniversary of Patreon support in the past month or so. If you enjoyed this video and you feel like you could support the channel for about the price of a coffee each month, then pop over to Patreon dot com forward slash just have a think to find out how you can do just that and have a look at all the exclusive perks you can enjoy while you’re there. And of course, you can hugely support me absolutely for free by hitting the like and subscribe buttons on YouTube and clicking on all notifications Doesn’t cost a penny to do that and it’s just a simple click away, either down there or on that icon there.**

**As always, thanks very much for watching! Have a great week, and remember to just have a think.**

**See you next week.**