**Back in twenty-twenty one, as the world was still dealing with a global pandemic, I reported on a grand plan being hatched by Indian Prime Minister Narendra Modi to create some sixty gigawatts of additional solar photovoltaic generating capacity in his country within three years, to help them kick their dependence on dirty coal in their electricity grid system. One of the biggest challenges Modi faced at the time was a scarcity of spare useable land to site the millions of panels that would be required to realise his goal.**

**So, his clever boffins used a bit of good old lateral thinking and came up with a strategy to locate a proportion of those panels above existing agricultural land and along some of India’s super long and super straight canals.**

**The idea was greeted with some enthusiasm around the world. The concepts of ‘Agrivoltaics’ and ‘Solar Canals’ have been now embraced by China, and they’re gaining traction in Australia, Europe and North America too.**

**Fast forward to November twenty-twenty-four, and India has very nearly achieved its capacity goal, having installed an additional fifty-four-point-four-seven Gigawatts worth over and above its existing twenty-twenty-one capacity. The country now has a total of almost ninety-five gigawatts, which is about twenty gigawatts more than the entire UK grid – just in solar PV alone.**

**But it’s been anything but plain sailing on the sub-continent, with only a small proportion of installations happening on agricultural land or above waterways amid developers’ complaints about high installation costs and low competitiveness.**

**So, are these things a genuine gamechanger, or are we deluding ourselves…again?**

**Hello and welcome to Just Have a Think**

**If you’re a regular viewer then you will have heard me quote a now well-worn statistic about our warming climate several times over the years, which is that for every one degree Celsius of additional planetary warming, our atmosphere is able to retain seven percent more moisture.**

**And in case you hadn’t spotted it, the average temperature increase compared to pre-industrial levels across the whole of twenty-twenty-four was roughly one-point-SIX degrees Celsius. A bit of simple arithmetic would suggest there might now therefore be as much as eleven percent more moisture in the air.**

**That’s moisture that should be in the ground, and on a planetary scale, it’s having a rather unsettling effect on the systems that we humans have painstakingly built our civilisations on for the last ten thousand years or so. The timing, intensity, and distribution of rainfall is now being severely disrupted. Regions dependent on predictable seasonal rainfall like monsoons are suffering a double whammy, with extreme UNSEASONAL precipitation events AND extreme droughts. Rising temperatures exacerbate the frequency and intensity of droughts all over the planet, especially in already arid and semi-arid regions like sub-Saharan Africa, India, China, Australia and the western United States. In regions like the Himalayas and the Rocky Mountains, snow and glacier melt contribute significantly to irrigation water. Global warming is accelerating the loss of those frozen water reserves, threatening long-term water availability for agriculture.**

**Higher temperatures increase plant evapotranspiration rates as well, causing crops to require more water. That puts even more stress on water supplies, leading to aquifer depletion in key agricultural areas in the countries I just mentioned, and those higher temperatures increase the rate of evaporation from open water surfaces like canals, lakes, and reservoirs, a problem which is exacerbated by changing wind speeds and patterns that further accelerate evaporation by transporting moisture away from water surfaces more efficiently.**

**So, you know, it’s a problem. And that’s why, on paper at least, providing some sort of cover over agricultural land and canals to minimise water loss looks like an extremely important initiative. And if solar panels are used to provide that cover, then surely, it’s a ‘win-win’ right?**

**Well, yes absolutely, in theory, but what about those high costs I mentioned earlier?**

**Several recent research papers have assessed the infrastructure required to construct these projects.**

**Obviously, you need much taller structures to mount solar panels above fields if you want any kind of effective land management to continue underneath, and a similar constraint exists over canals as well. And that does add a significant extra burden to the CAPEX of any project.**

**But it’s not quite as prohibitive as you might think. A** [**twenty-twenty-four analysis**](https://www.pv-tech.org/fraunhofer-ise-ground-mounted-solar-lowest-lcoe-germany/?utm_source=chatgpt.com) **by the Fraunhofer Institute in Germany calculated the levelised cost of electricity, or LCOE of agrivoltaics to be between seven and twelve eurocents per kilowatt hour. That’s more expensive than simply mounting solar panels on the ground, but it’s actually less expensive than a typical domestic rooftop installation. And, by the way, it’s still far cheaper than any of this stuff over here, including nuclear, which can be as much as fifty cents per kilowatt-hour.**

**Nevertheless, in places like Gujarat in India, where much of the vast areas around their irrigation canals are designated as wasteland despite clear evidence to the contrary, developers looking for q short-term return on their investment are questioning why they should go to the trouble and expense of construction over the waterways when they could more cheaply and easily just plonk the same panels on the ground right next door.**

**And that, my friends, is a perfect example of why, in the humble opinion of this presenter, it’s a really bad idea to devolve national infrastructure decisions to company executives driven solely by market forces that require them to produce ever-increasing financial results for their shareholders on a quarterly basis. And at the risk of sounding like some kind of rabid socialist, its precisely why governments need to be more proactively involved in these kinds of projects, with stronger climate mitigation policy and attractive economic incentives for developers to motivate them to do the right thing, plus regulations and penalties to dissuade them from doing the wrong thing.**

**Because the POSITIVE BENEFITS of agrivoltaics and solar canals really shouldn’t be underestimated…**

**Case studies of solar canals for example, have shown that the panels themselves perform more efficiently as a result of the cooler microclimate over the water. And the shade from the panels has been shown to significantly reduce the evaporation problem I mentioned earlier AND help to eradicate unwanted aquatic weed growth.**

**This** [**twenty-twenty-one**](chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https:/escholarship.org/content/qt8cj5j07p/qt8cj5j07p_noSplash_da7010b14e05c8089355f67e9f443a6f.pdf?utm_source=chatgpt.com) **study from the University of California analysed hydrologic and techno-economic simulations of solar PV panels covering California’s six-thousand kilometre canal network. The paper’s authors found that over-canal solar could reduce annual evaporation by an average of around thirty-nine thousand cubic metres per kilometre of canal. Which is astonishing. Plus, the financial benefits from shading the canals were shown to outweigh the additional up-front infrastructure costs.**

**The researchers used a metric known as ‘net present value’ or NPV to compare different solar PV systems. Essentially NPV is a financial metric used to evaluate the long-term profitability of an investment or project. It uses a fancy formula to account for variables like initial investment cost, cash inflow over time and the discount rate over that time-period. A project with a positive NPV generates more value than it costs to build, and a project with a negative NPV is expected to lose value overall.**

**It looks complicated but it's actually quite a neat way for investors and policymakers to properly evaluate the long-term appeal of comparative propositions. This research demonstrated that the NPV of solar canal projects exceeded conventional ground-mounted solar by between twenty and fifty percent depending on region.**

**A perfect example of that is Project Nexus in California, run by a company called Solar AquaGrid. It’s a huge trial on some of The Golden State’s vast canal network to test different configurations, sizes, tilt angles and clearances to see what gives the best bang for the buck in the wide variety of waterways available. As I’m sure you know, California has suffered years and years of crippling drought, exacerbated by a rapidly warming climate that is changing the entire hydrological cycle of the region. Without irrigation canals the agriculture and viticulture that the Central Valley is famous for would be gone, so there’s a huge incentive to apply solutions to what is now an emergency for the state. The project over the Turlock Irrigation District’s canals broke ground in late twenty-twenty-two and is due for commissioning in the early part of twenty-twenty-five with a generating capacity of about one megawatt.**

**Meanwhile, back over in India, despite the misgivings of some developers, Gujarat launched its Canal Solar Power Project back in twenty-twelve with a one- megawatt pilot over the Narmada branch canal near Chandrasan village. Since then, the initiative has expanded, with plans to cover nineteen thousand kilometres of canals, potentially creating up to two-point-two gigawatts of generating capacity and conserving significant land and water resources.**

**Similar long-term co-benefits exist with agrivoltaics. People far smarter than me have worked out that there’s a limit to how much sun any individual plant can actually use.**

**It’s something known as the light saturation point. Any extra light received beyond that point makes no difference at all to the plant’s photosynthesis. All it does is make the plant sweat, which makes it more thirsty, which means the farmers in very hot and sunny regions - you know, where all those extreme droughts are happening more regularly- have to put in more irrigation to keep their crops alive, which uses more of that precious water that they haven’t got anymore, on account of all that drought.**

**You get the idea?**

**But, by strategically placing solar panels directly above a crop growing area, it’s possible to precisely regulate and optimise how much sunlight reaches each plant to maximum growth and minimise water loss. Then all the excess sunlight can be captured on the upper side of the solar panels to generate energy.**

**And if the panels are raised up high enough above the ground, then livestock, farm workers and even agricultural machinery can all operate very happily in the cool shade beneath the canopy.**

**Plus, transpiration from the crops helps to keep the solar panels cool, which helps them to work more efficiently.**

**According to a study by Oregon State University, panels positioned correctly above plants can produce as much as ten percent more electricity.**

**Systems like this are already in use. French agrivoltaics company Sun’Agri announced recently that high level panels at two if its vineyard sites in the Domaine de Nidolères in the Pyrénées Orientales increased grape yields by twenty to sixty percent in twenty-twenty-four by optimizing the microclimate, increasing humidity, and reducing irrigation requirements by as much as seventy percent. The panels help to regulate temperature fluctuations, reduce summer heat damage and protect against winter frost.**

**And projects are springing up in various other parts of the world too, including this pilot project in Australia, with a relatively small capacity of twenty kilowatts. It’s one of only two officially recognised agrivoltaic installations there, but it’s seen by many as a blueprint for a country facing many of the challenges that we saw in California earlier on.**

**Then there’s behemoth projects like the one-hundred and seven square kilometre Binhe New District on the banks of the Yellow River in China. Since twenty-sixteen Huawei and the Baofong Group have been building out what will ultimately be a gigawatts worth of solar canopies over goji berry plantations. In just a few years the panels have reduced soil evaporation by as much as forty percent and increased vegetation cover by nearly ninety percent, turning that patch of desert into an oasis, creating eighty-thousand new jobs for the local population.**

**According to** [**this**](chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https:/www.ssii.org/wp-content/uploads/2024/09/SI2_FARMS-Survey-Report_Final.pdf?utm_source=chatgpt.com) **recent study by the US Solar and Storage Industries Institute, eighty-three percent of all utility-scale solar PV development in United States up to twenty-forty is expected to take place on agricultural land. Their survey found that seventy percent of US farmers are open to the idea of large-scale agrivoltaics on farmland, but they highlight challenges, not least of which is getting permits and overcoming a somewhat irrational public perception that solar panels will displace agricultural activity and jeopardise food security for the country. Nothing could be further from the truth though. Most US farmers recognise agrivoltaics as a complimentary activity, not a replacement for their core role as food producers, but it represents a crucial secondary revenue stream that in many cases might just keep a farm in business, which is actually good news for the US consumer.**

**We’ve all seen the cost charts for solar PV in recent years, haven’t we?**

**Basically, dropping like a stone and still falling even now. So, any investor equipped with a modicum of critical thinking, even if they’re not swayed by the blindingly obvious environmental and climate benefits of agrivoltaics and solar canals, would, perhaps with a little nudge from government incentives, surely find the medium to long term financial benefits to be compelling enough to take the plunge.**

**But what do you think? Are you all in on renewable technology and the green transition, or are you looking forward to the destruction of regulation and a return to economies driven purely by quarterly results, like the one being enthusiastically encouraged by the incoming administration over in the United States. Maybe you work in one of these industries and you have some useful insights that you can share with us all?**

**Whatever your views and news, the place to leave your thoughts, as always, is in the comments section below.**

**That’s it for this week though. Thanks, as always to the amazing folks who support my work via Patreon, and who enable me to keep ads and sponsorship messages out of your way. Don’t forget to jump over to Patreon dot com forward slash just have a think to find out how you can join them and have a look at all the exclusive perks you can get there, including free membership. And if you enjoyed this video then you really can hugely support me by hitting the subscribe button on YouTube and clicking on all notifications. It won’t cost you a penny to do that and it’s just a simple click away, either down there or on that icon there.**

**Most important of all though, thanks very much for watching! Have a great week, and remember to just have a think.**

**See you next week**