**You’ve probably spotted that the human species faces one or two …**

**‘existential challenges’ in the twenty first century, even AFTER we get ourselves past the current clear and present danger of a global pandemic.**

**Climate change is of course the overarching crisis of our time, but two of the really major sub-categories within that umbrella term are population density and land scarcity.**

**Now of course, if you’re watching this in somewhere like Canada you might be forgiven for wondering what all the fuss is about, given that your country only has four human beings for every square kilometre of territory. That’s less than a sixth of the global average, beaten only by Greenland, Mongolia, Australia and Namibia.**

**It gets a bit busier over here in Western Europe of course. The little island nation where I live is more than ten times as densely populated as that global average**

**But few countries struggle with population density and land availability more than the mighty subcontinent of India, which is home to almost one point four billion people, seventy percent of whom rely on agricultural land for their income.**

**That country also gets three hundred days of sunshine every year, a fact that hasn’t escaped the attention of Prime Minister Narendra Modi who is determined to wean his country off of its disastrous addiction to coal, and instead make India a world leader in renewable energy, with a plan to add more than sixty gigawatts of solar power capacity just in the next three years. The trouble is, all those panels are going to take up a lot of precious land, which will inevitably put even more pressure on farmers who are already struggling to make a living.**

**In recent years though, some very clever engineers have been applying some seriously smart lateral thinking to the challenge.**

**They’ve designed a solar photovoltaic system that can be installed directly above a waterway, and in the process, they appear to have solved more problems than they bargained for.**

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

**At the risk of stating the blindingly obvious, India is a pretty big country.**

**The huge tracts of agricultural land that support the lives and livelihoods of hundreds of millions of people have historically relied on water from the monsoon and the country’s seven major rivers, which split off into numerous tributaries criss-crossing the nation. Farmers have been manipulating and diverting those waterways to improve their crop yields for thousands of years.**

**During the medieval period the Sultanate rulers started to build out a more structured and extensive network of irrigation canals providing water resources to agricultural lands in the north of the country, and over the ensuing centuries the network got improved and extended still further.**

**When the British arrived in eighteen hundred, they applied their typically gung-ho attitude to taming nature and set about hacking down jungles, and commandeering land all over the place to make way for tea plantations for export back to Europe, and poppy and opium farms for export to China.**

**Within a century the area of irrigated land in India had increased from eight hundred thousand hectares to about thirteen million hectares, and by the time the British left in the middle of the last century, they’d increased that still further to twenty-two million.**

**Today about half of India’s one hundred and forty million hectares of agricultural land is irrigated by groundwater wells and canals.**

**The state of Gujarat alone has a canal network of eighty thousand kilometres. If they were all laid end to end they’d reach around the circumference of the entire planet…twice.**

**Sadly, the electricity grid operators were a little less successful in the twentieth century. At the turn of the twenty first century, fifty seven percent of the Indian population still had no access to any electrical power and that statistic was heavily skewed towards the remote villages where hundreds of millions of agricultural workers lived. One of the biggest disadvantages those villagers suffered was the lack of light after sunset which meant girls, in particular, couldn’t easily study during the evenings. In most rural Indian families, it’s the girls and women who do all the household chores. While the boys have their afternoons free to study during daylight hours, Mums and daughters are still preparing food and washing dishes well after dark, and only then does a daughter have time to herself. So the challenge was how to get power to those remote communities in an economical and low carbon way.**

**It was as the then Chief Minister of Gujurat that Narendra Modi himself first tabled the idea of canal top solar in twenty eleven. The main motivator back then was the prospect of saving the government huge amounts of time and money.**

**Solar power installations can be built much faster than large coal or gas fired power stations. And using the canal network instead of searching for precious new land to commandeer reduced costs and sped up the process still further.**

**So, in 2014, a seven hundred and fifty-mile pilot project was opened, followed by Gujarat’s first canal top solar power plant in 2015 at a remarkably modest cost of eighteen point three million dollars.**

**The electricity from the plant doesn’t just provide power for homes but also for farmers during the energy-intensive irrigation season. Then in the off-season the plant diverts most of its generation either to the state grid, or to other distribution companies.**

**And here’s where those extra bonus benefits start to reveal themselves. The first and most obvious advantage is that by generating power locally, very close to where it’ll be used, transmission losses are minimised, and the local grid is strengthened.**

**The second is retention of moisture.**

**In states like Gujarat, Rajasthan and Maharashtra, where canals are mostly used for irrigation, water evaporation is a big problem. And back in 2010 there were something like a hundred and fifty thousand villages across India that faced drinking water scarcity. Covering the canals with solar panels significantly reduces water loss, leaving more available for crops and people.**

**The third advantage is panel efficiency. One of the biggest ironies of solar panels is that they don’t like to get too hot. Higher temperatures tend to reduce their ability to generate current. By Installing the panels above a source of running water they stay cooler, which improves efficiency by as much as five percent, and that also lengthens the useful working life of the panels compared to their land-based counterparts.**

**And the installers have also found that the shading provided by the panels is reducing the troublesome algal blooms in the canals that can clog up pumps and make the water toxic.**

**There are some drawbacks though. Canal top solar is more expensive to set up than land-based systems, mainly because you need heavy duty galvanised support frames that won’t react with the constant exposure to moisture. The panels also needs to be pointing south to make the best use of the sun throughout the day. Indian canal systems tend to meaner a bit, so not every stretch will be suitable for these installations. And they tend to vary in width as well – the wider stretches may prove uneconomical to span, and the very narrow parts probably won’t allow enough panels across them to make them economically viable. And of course, just like any solar panels, especially in hot dusty countries, they need to be constantly cleaned to maintain that optimum working efficiency, so there’s a workforce cost involved there, although remotely controlled and automated cleaning systems are being developed too.**

**And because they’re spread over a very large area that can’t be walled in or fenced off, there’s also a bit of a risk of theft, so in some places there’s an additional cost for security systems to be installed to protect the hardware.**

**Nevertheless, it’s been calculated that if just thirty percent of Gujarat’s eighteen thousand-kilometre canal network was fitted out with these panels, that’d save about ninety thousand acres of land and provide eighteen gigawatts of power capacity, which is about a fifth of India’s total solar power target for 2022.**

**Eight other states have now commenced or completed canal top projects of their own, most notably a forty kilometre, one hundred-megawatt system on the canals branching off the Narmada river, and a six megawatt supply set up at Kochi airport in Kerala. Kochi is the first airport in India to be fully powered by solar energy, and this new system makes good use of the Chengaltodu canal that runs right through middle of it.**

**India got a bit battered by the world’s largest lockdown in 2020. Solar installations dropped by seventy two percent last year. Despite that though, according to Bloomberg New Energy Finance, bids to develop new solar projects continued to set new records, so as soon as the power companies get back on their feet, solar will once again become the cheapest and most attractive option for expanding the countries energy network, and these smart solar canals may well play a significant role in making that happen.**

**One plus point of last year’s lockdown in India was that everyone got to see how clear the sky was when it wasn’t filled with toxic pollution – providing a portent of what it’ll be like to live and work in that great country once renewable energy has displaced fossil fuels for good.**

**Now I know there’s a growing number of folks watching this channel over in India, and no doubt some of you will have direct experience of these systems, so it’d be great to get your views and feedback in the comments section below.**

**That’s it for this week though.**

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**As always, thanks very much for watching, have a great week, and remember to Just Have a Think.
See you next week**