**I’ve been talking a lot about energy storage recently, mostly in the form of various competing battery chemistries, but also in some other more imaginative technologies like molten salt, hot rocks, liquid air, and even your hot water tank at home.**

**Energy storage is, and will continue to be, an absolutely crucial factor in the mass adoption of intermittent renewable power sources like wind and solar. After all, we’ve all heard the old cliché that the sun doesn’t always shine, and the wind doesn’t always blow, haven’t we?**

**But that cliché only really holds true if your horizons are strictly limited to… well…the horizon! If you’re prepared to step outside your own sphere of existence, then a whole kaleidoscope of possibilities suddenly comes into focus. And you don’t need hallucinogenic drugs for the trip either. It can be achieved by the simple expedient of taking a look at an atlas!**

**Because of course in reality, the sun *is* always shining, and the wind *is* always blowing…somewhere on planet earth. Twenty four hours a day, three hundred and sixty five days a year.**

**So, if there was a way of sending the power from the sun and the wind instantaneously, from wherever it’s happening at any given moment to wherever it’s needed at that precise time, then we would effectively have ourselves a network of global baseload renewable energy.**

**Now, if that all sounds a bit ‘Star Trek’ to you, then think again, because that’s precisely the kind of infrastructure that’s already being developed to move energy between east and west, and from mid-latitude regions up to the northern hemisphere, where 90% of the human species lives and works.**

**One of the most ambitious of those projects has just been unveiled by a UK company called X-links, and it looks set to blaze a trail for a revolution in the way we operate the electricity grids of the future.**

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

**Moving very large quantities of electricity over very long distances through high voltage direct current or HVDC cables is not a new concept. There’s been a high voltage cable running from the Pacific North-West down to Los Angeles for decades. There are several in Europe and Asia, and of course there’s the monster 1.1 million volt Changji-Guquan project, carrying twelve thousand megawatts of power over three thousand kilometres from the wind and solar farms in the northwest of China to the urban conurbations on the country’s East coast, supplying more than twenty six million people with electricity.**

**So, the technology is well used and well proven.**

**But few projects match the scale and scope of the infrastructure that X-Links are currently putting together. It’s called the Morocco-UK Power Project and, to borrow a strapline from an old TV commercial, it’ll do ‘exactly what it says on the tin!’**

**That means harnessing the reliable daily sunshine and wind that hits South Morocco three hundred and sixty five days a year, and sending it into the UK electricity grid via massive subsea HVDC cables.**

**Morocco is already aggressively pursuing its own transition to a grid supplied by renewables. In a recent webchat, the founder and CEO of X-Links, Simon Morrish, explained to me that he and his team were acutely conscious of this vital ongoing work, so they liaised very closely with the Moroccan government to ensure they didn’t use any land that may otherwise have been used by the local population for their own energy needs. Nevertheless, the site they’ve secured covers approximately fifteen hundred square kilometres, or about five hundred and eighty square miles. That’s an area the size of London – which, for a wind and solar farm, is enormous. But, you could easily fit the lower forty eight states of America within the borders of the Sahara Desert and still have plenty of room left over, so in that context, the footprint of the Morocco-UK Power Project is fairly negligible.**

**What it’ll provide though, is space to install seven gigawatts of solar PV panels, plus three point five gigawatts of wind power and a five gigawatt/ twenty gigawatt hour battery energy storage facility.**

**Those are some pretty huge numbers!**

**When complete, the site will provide enough power for more than seven million homes, representing eight percent of the electricity demand, via two one point eight gigawatt grid connections that have already been approved by the UK National Grid for installation on the north Devon coast.**

**The solar PV power element of the Morocco site is fairly self-explanatory, I suppose. You get sunshine every day, for more or less the same amount of time every day, throughout the whole year, without the daily and seasonal intermittency that we have to put up with in more northern climes.**

**What may not be quite so intuitive though, is the potential of wind power in the same location. It turns out that the convection currents caused by the sun’s movement across the desert sky during the day cause quite significant and predictable winds to pick up in the late afternoon. And those winds keep blowing all the way into the late evening and night-time. That’s perfect timing to keep the electrons flowing after the sun’s gone down, but it also beautifully matches the high demand spikes of the UK grid as everyone comes home from work and puts the kettle on. In fact, the wind capacity factor at the site, which is how the industry assesses location feasibility, is fifty five percent. That compares very favourably to the forty percent capacity factor that the UK’s offshore windfarms achieve.**

**The on-site battery storage facility acts like a kind of massive control box to regulate the supply at the right frequency throughout the hours of darkness, reaching a state of full discharge just as the sun comes up each morning.**

**All told, the facility will be producing at a capacity of three point six gigawatts for an average of twenty hours a day.**

**Effectively what you’ve got here is precisely the kind of baseload power from renewables that really would have seemed like science fiction just a few years ago.**

**The combination of generation options also optimises the carrying capacity of the HVDC cables. The precise calculations for establishing cable load factors involves a lot of quite complicated variables that are outside the scope of this video, but in round figures, the solar PV panels just on their own provide a load factor on the cables of just over forty percent. Adding wind power bumps that number up to around seventy percent, and when you include the battery storage the load factor gets close to eighty five percent.**

**But manufacturing those enormous cables has arguably turned out to be the biggest challenge of the entire project.**

**The overall distance they’ll need to cover is three thousand eight hundred kilometres, but to ensure security of supply there’ll be four cables in total. That’s a total of fifteen thousand two hundred kilometres. Global production capacity of this kind of monster cable is estimated to be something in the region of four thousand kilometres a year, so X-Links would require the entire world’s supply every year for four years!**

**And guess what – the entire world’s supply is, unsurprisingly, already allocated to other projects, so if they were going to source the kit from existing manufacturers, X-links would be facing high prices and lead times of at least five years.**

**A plant definition study, commissioned from a company that specialises in building cable extrusion factories, revealed that it’d be more cost effective for X-links to set up their own production facility from scratch and build the HVDC cables themselves. So, they began looking for appropriate sites in coastal locations around the UK. And they found just the spot up at Hunterston on the West Coast of Scotland, where an existing nuclear power plant is due to close in 2023 with the loss of 500 jobs. X-links plan to build a new six-line cable extrusion factory on a nearby site that will become the largest cable manufacturing facility in the world, creating nine hundred well-paid, high-tech manufacturing jobs, hopefully absorbing many of the five hundred redundancies from the power plant.**

**All in, X-Links projects to reach an overall cost of electricity of £48 per MWh, which is the price they are aiming to secure in the UK government’s Contracts for Difference or CfD scheme.**

**CfDs are long-term contracts between the government and electricity generators that allow the generator to stabilise their revenue at a pre-agreed level, known as the strike price, for the entire duration of the contract. When the market price for electricity falls below the strike price set out in the contract, the CfD scheme operator makes up the difference in payments to the generator. And when the market price is above the strike price, the generator pays that difference back to the scheme operator.**

**UK Offshore wind for example, has a CfD cost of £40 per MWh. Now, if you were a minister in the UK government’s Department of Business, Energy and Industrial Strategy, you might be tempted to compare the £40 cost of offshore wind to the £48 projected cost of X-links wind and solar and come to the conclusion that you’d be better off sticking with the cheaper option. But that would be to overlook the critical difference between the two technologies. UK offshore wind remains a very intermittent source of power generation, and without wishing to blow your mind too much, that actually creates an unhelpful contortion of the CfD scheme. When there’s loads of wind and the turbines are producing their peak output, electricity prices drop, which means the offshore wind generators are getting money from the CfD scheme to guarantee their £40 contract price. But when there’s no wind and consequently less electricity being generated, then market prices tend to go up, often above the strike price of £40. But because the offshore wind generators are not actually producing very much electricity at those times, there’s very little for them to pay back to the CfD scheme operator. Effectively that’s a subsidy that can only be enjoyed by an intermittent power source.**

**By contrast, the X-Links project will provide reliable baseload power, so they will most likely be a significant net contributor to the coffers of the UK exchequer, which makes them an unsubsidised power source at £48 per MWh. Arguably then, a much more appropriate comparison would be with other baseload power generation facilities currently being built in the UK, like the Hinkley Point C nuclear reactor for example. Hinkley has secured a CfD price of £92.50 per MWh, nearly twice as much as the Moroccan facility. In that context, X-Links starts to look like extremely good value for money indeed. Those negotiations are ongoing and are being led by X-Links exec- chair Sir Dave Lewis, who UK viewers may recognise as the ex-Chief Executive of our largest supermarket chain, Tesco.**

**Meanwhile back in Morocco, X-Links is making progress in gaining the requisite regulatory and government approvals, so that the country can benefit from the ten thousand jobs that’ll be created during the construction of the facility - two thousand of which will become permanent positions.**

**The total cost of the project, including the new cable extrusion factory, is sixteen billion pounds, with forty million pounds already secured for the development phase. Construction is due to commence in twenty twenty-five with the first system scheduled to go online in twenty twenty-seven.**

**The Morocco UK Power Project is probably pushing the boundaries of what’s been achieved to date, and I’m sure there are those who quite understandably argue that we should be focussing far more on distributed energy solutions and be less reliant on large, centralised facilities like this one. As an owner of rooftop solar panels myself, I would certainly agree that those distributed energy generation sources will play an absolutely vital role in the transition to a more sustainable future. But here in the UK we now have only fourteen years left to achieve a mandated 100% net zero carbon electricity grid. There’s a lot of nuclear and gas power due to come offline in the coming years, and despite the fine words of our current government, it’s difficult to see a legitimate solution for baseload energy in the short term without projects like X-Links. The new nuclear power plants currently under construction are taking far too long and are catastrophically over budget, and even the small modular reactors being developed by Rolls Royce won’t be online until 2035 at the very earliest so, right now, the case for baseload renewables via long distance HVDC cables looks pretty compelling.**

**No doubt there’ll be plenty of you folks out there who have strong views on these kinds of projects one way or the other, so if you do, then why not jump down to the comments section below and share your thoughts there.**

**That’s it for this week though.**

**As always, a big thank you to the folks at Patreon who keep these videos completely independent and ad-free. And a quick shout out to the folks who’ve joined since last time with pledges of ten dollars or more a month.**

**They are**

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**Gerald Farmer**

**Mohammad Syahrial**

**Neil Gray**

**Andrew Graham**

**Neil Oakey**

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**Todd Sears**

**And**

**Andre Canelhas**

**And of course, a huge thank you to everyone else who’s joined since last time too.**

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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.**