**I’m sitting here all nice and smug in the middle of the windiest country in Europe. More than eleven gigawatts of the UK’s one hundred gigawatts of total electricity generation capacity now come from some of the world’s largest wind farms out in the North Sea. Lucky me. That offshore wind power, plus another twelve gigawatts of onshore wind, thirteen gigawatts of solar, and six gigawatts of nuclear capacity, has meant the UK has been able to genuinely lower its carbon emissions over recent years. Twenty-twenty-three apparently saw a further five-point-four percent reduction.**

**But transmitting those electrons from where they’re generated to where they’re needed is easier said than done. Sending electricity via undersea cables to the nearest shoreline is complicated enough, but trying to get permission to build out transmission infrastructure from where the power comes on to land to where it’s actually needed is proving to be a bit of a nightmare.**

**One idea currently being rattled around as a potential solution is to keep much more of that new geographical transmission infrastructure out at sea, surrounding the coast line, with cables spurring off it at various junctures to plug directly into each region’s already existing substations and pylon networks.**

**Nice idea in principle, but it sounds bloody expensive to me. So, what am I missing here?**

**Hello and welcome to Just have a think,**

**Now, first things first - I had a bit of spare time on my hands after the excitement of the recent Everything Electric live show in London, so I painted my living room wall and bought some green stuff. You know – like you do! I hope you like it, but if you don’t then that’s fine too. I’m not painting it again, it was a right pain in the ar… by the way if you want to see the six brilliant discussion panels that I was privileged enough to host at that Everything Electric event, then you can find out all about how to do that by jumping over to my Patreon page, where you can now join for free, so that you can have a good look around the site BEFORE deciding whether you want to part with any of your hard earned cash to support the channel.**

**Anyway, enough of all that Dave. Get back to the topic in hand!**

**So, offshore electricity grids then. They weren’t really a thing when we were all happily burning coal, oil and gas for our energy needs, blissfully unaware of the catastrophic consequences of our actions. But those pesky renewable energy developers had to start making a nuisance of themselves didn’t they, building out all that wind and solar PV infrastructure and disrupting the status quo we’d all got used to just because they apparently want to help prevent…you know ‘the extinction of the human species’ – bloody do-gooders.**

**And building turbines and solar panels on the land wasn’t good enough for them either, was it? Oh no. They had to go poncing off into the ocean to start building really massive versions out there as well, didn’t they?**

**We Europeans are some of the worst culprits. The two largest offshore wind farms in the world are the Hornsea One and Hornsea Two installations up here off the North East coast of England, with a combined generating capacity of two-point-five gigawatts. And Hornsea Three has recently been approved, which just on its own will have a generating capacity of almost three gigawatts, providing power to more than three-point-three million UK homes. The government’s stated target is to have fifty gigawatts of offshore wind power up and running by twenty-thirty.**

**The UK is not unique in chasing the potential of offshore wind, of course. You folks over in the States are grappling with the pros and cons right now, aren’t you? According to the National Oceanic and Atmospheric Administration or NOAA, some forty percent of Americans live in coastline counties. That’s about a hundred and thirty million people, all of whom could very easily be served by offshore wind IF the infrastructure could be put in place in a way that was cost effective, environmentally sensitive, and acceptable to local residents. Same thing around the myriad islands of Indonesia, which has a population of about two hundred and eighty million, AND in Japan with a hundred and thirty million people, the East coast of China where forty percent of its one-point-four billion population live, and even the coastlines of India and Africa have enormous scope for harnessing the power of offshore wind to decarbonise energy generation for literally hundreds of millions of people.**

**So, getting it right first time is a pretty big deal. In July twenty-twenty-two the UK National Grid and the UK Electricity System Operator, or ESO published a document called the Holistic Network Design as part of the UK government’s Offshore Transmission Network Review, or OTNR.**

**The document provides connection recommendations for an additional twenty-three gigawatts of offshore wind power plus all the associated transmission network infrastructure, which it says will save UK consumers about five-point-five billion quid over the forty-year life span of the project. How come? Well, although building out additional transmission infrastructure OFFSHORE will bump up the capital costs by seven-point-six billion pounds, ESO reckons this would be well outweighed by more than thirteen billion pounds worth of savings in so called ‘constraint costs’.**

**So, what are they then? Well, they’re the costs that the grid currently incurs when it has to curtail, or switch off, wind turbines in order to decrease generation output in one part of the country, and RAMP UP turbines to INCREASE generation output in a different part of the country to keep everything balanced. This extra twenty-three gigawatts of offshore supply would go along way to eradicating that activity. And here’s how they’re proposing to achieve it.**

**This is a map of our windy British Isles and, by the way, if you’re watching this from elsewhere in the world then this little exercise is probably still worth watching because it serves as a kind of blueprint for what you may well be up against when your network operators finally get off the pot and start getting organised. So, we’ve got an existing transmission network, which just like most other places in the world is a bunch of reasonably unattractive pylons strewn all over the countryside.**

**Then we’ve got the locations of all the existing wind farms, which we Brits can rather smugly point to as being ‘really quite extensive’. Now, here’s the thing. Most of those wind farms are currently hooked up in what the electrical engineers call a radial pattern, which is essentially exactly how your lights are wired up at home. In other words, a wire goes from point A to point B and then point C etc.**

**Sounds a bit obvious when you say it out loud, doesn’t? And it is indeed the least expensive and most direct way of moving electricity around.**

**But it does effectively mean that each wind farm is operating in isolation, run by different developers that are kind of competing with each other to get as many of THEIR electrons as possible onto the grid in order to maximise their revenue.**

**And that’s largely where those constraint costs come into the equation, as the central grid operator shuffles stuff around to make it all work. So, in the long run it’s actually more expensive at the other end of the wire, well away from the balance sheets of the generators and firmly in the remit of the consumer (which is you and me in case you’ve nodded off).**

**Now in some locations a radial connection is actually the only practical choice, but in lots of other areas, it makes much more sense to go for a co-ordinated connection where all the competing operators sit down over a nice cup of tea and have a civilised chat about how they can play nicely together and share the transmission wires to the betterment of all humankind, which I’m sure you’ll agree is something that always works well in a commercial environment, doesn’t it?**

**Anyway, whatever you might think about it, that’s the plan. ESO’s Holistic Network Design recommends that of the eighteen new wind farms in scope for future development, represented by these yellow diamonds, nine of them will use co-ordinated connections, essentially much more like a grid system. Wind farms connected in a coordinated way aren’t just better for long term economics, they’re way more environmentally efficient too.**

**ESO reckons they’ll lead to a reduction of some two million tonnes in cumulative CO2 emissions from METHANE GAS powered generation between twenty-thirty and twenty-thirty-two – equivalent to grounding all UK domestic flights for a year.**

**They’ll do that through a combination of high voltage alternating current, or HVAC, cables for short distances and high voltage direct current, or HVDC, cables for longer distances.**

**We did a deeper dive into the relative merits of those two systems in a video a couple of years ago, which you can jump back to by clicking up there somewhere or by following the link in the description. Essentially alternating current is a very ‘lossy’ way to transmit electricity over long distances, and even more lossy if you stick the cable under water or underground. For reasons of physics which we won’t go into here, direct current doesn’t suffer those losses, so although you’ve got the added expense and hassle of converting it from AC to DC and back again at each end for the wire, the longer that wire is, the better the numbers stack up for HVDC. Longer cable runs also means fewer cables overall.**

**ESO says their recommended design reduces the total number of cables being laid to shore by up to a third, which significantly reduces the impact on marine ecosystems. And the way those cable runs have been configured means that the whole system is future proofed and already equipped to accommodate any additional wind farms that may quit likely come online towards mid-century.**

**Not everyone’s cock-a-hoop about the proposal though. There are several regions that don’t appear to be getting the benefit of this new technology, most notably North Lincolnshire and East Anglia, where the residents are facing the imposition of hundreds of miles of additional fifty-metre-high onshore pylons running all the way from Grimsby up here to Tilbury in Essex down here. That has caused something of a kerfuffle as you can probably imagine, with local residents quite understandably asking why on earth the same long-sighted economies and efficiencies of an offshore grid network haven’t been applied to them when they seem to make so much sense everywhere else. Seems like a fair question to me, and as a direct result of collective action and protests, backed up in Parliament by local elected representatives, the UK government has now agreed to fund a study into the viability of using offshore cables to connect two further regional offshore windfarms directly into the National Grid at coastal substations instead of using onshore pylons.**

**So, yet another example of how collective action really can make a difference, and I guess also another reminder that, as with pretty much everything else in the global energy transition, there are still a lot of bumps in the road, and winning the hearts and minds of ordinary people like you and me will arguably be one of the biggest challenges, not just in energy, but in the other two key transitional sectors of food and transport as well.**

**But the basic blue print for offshore electricity grids does look to be pretty robust. Imagine a network like this running up and down the US Eastern Seaboard or in the deep waters off the western US continental shelf enabling the deployment of hundreds of floating turbines like the behemoth fourteen megawatt Haliade X design from GE.**

**The enormous economic and environmental prizes are there for the taking.**

**We just need those nice grey haired old gentlemen running the power companies to have a good old group hug and apply some long -sighted, cooperative critical thinking to the challenge. And I can’t think of a single thing that could possibly go wrong with that!**

**Anyway, that’s it for this week. A massive thank you, as always, to the amazing folks who support the channel via Patreon. And I must just give a quick shout out to some folks who joined recently with support of ten dollars or more a month. They are Qais Zakaria, Alberto Ortiz, Tony Thick, The Doctor, Bob Jansen, Claus Wichmann, Gary Salibrici, and Geoffrey Davies.**

**And of course, a huge thank you to everyone else who joined recently too. Patreon support means I keep the content completely independent and can keep ads and sponsorship messages out of your way. If you’d like to get more involved, then you can get exclusive early access to all my videos, pick the brains of fellow Patrons in discussion forums AND have a direct influence on the direction of the channel’s content by visiting patreon.dot.com forward slash just have a think.**

**And if you don’t want to miss out on notifications of new videos each week, then make sure you select the completely free option of clicking on that subscribe button and switching on all notifications, which you can do down there somewhere or by clicking on that icon there.**

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

**See you next week.**