**We humans have been harnessing the energy in flowing water for thousands of years. I’m sure we all know what a water wheel looks like, but just in case anyone’s missed it – here’s one in action.**

**Very quaint!**

**Today, flowing water in one form or another, accounts for about sixteen percent of all electricity generation around the world. According to the International Hydropower Association, the total installed capacity in twenty nineteen was thirteen hundred and eight gigawatts, generating more than four thousand three hundred terawatt hours of electricity.**

**The vast majority of that power comes from hydroelectric dams on large river systems, which have developed into extremely sophisticated and efficient engineering marvels. But, as we’ve discovered in previous videos on this channel, those dams also come with significant environmental impacts upstream and downstream as well as greenhouse gas emissions from their construction and from the reservoirs immediately behind them.**

**What we haven’t been quite so successful at, at least not so far anyway, is harnessing the almost unimaginable quantity of energy in our oceans. Wave and tidal power does exist of course, but high costs and limited availability of suitable sites have hampered progress towards large scale implementation.**

**That’s been changing quite rapidly in recent years though. New materials and turbine technologies are opening up a wider range of geographical locations, suggesting the total availability of tidal power may be much higher than previously assumed, and at a much more competitive cost with a far smaller environmental impact than large hydroelectric dams.**

**And at the end of April 2021 the world’s most powerful tidal turbine, boasting some pretty ground-breaking design features, was launched off the East coast of Scotland. So, could this be the gamechanger that the tidal energy industry has been looking for?**

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

**One of the biggest criticisms of renewables like wind and solar, is of course the old bugbear of intermittency. That unpredictability is being addressed to a large extent with modern energy storage solutions, many of which we’ve looked at on the channel. But tidal energy has the great advantage of being entirely predictable and reliable, because it’s driven by our orbit around the sun, and more importantly to our planet’s rotation combined with the gravitational pull of our moon’s orbit around us. All three of those dynamics look set to stay pretty regular for several million years to come, so you can see the appeal of using the tides to generate reliable renewable energy at potentially extremely large scale.**

**Plus, ocean water is more than eight hundred times denser than air, so, in theory you can generate vastly more energy per unit volume by sinking a turbine underwater than you can from putting one up in the wind.**

**The world's first large-scale tidal power plant went into operation way back in nineteen sixty-six at the Rance power station in Brittany, France. That facility remained the largest in the world right up until 2011, when the Sihwa Lake Tidal Power Station was built in South Korea. The ten turbines there have a combined generating capacity of two hundred and fifty-four megawatts. Both those installations are examples of a tidal barrage, otherwise known as a tidal range device. Essentially, they’re just dams, very similar to the type seen on major rivers around the world. But instead of using the flow of a river, they exploit the change in energy between high and low tides to turn their turbines and generate electricity. They’re very large, and relatively expensive. They also have to be constructed in locations like the mouth of an estuary, where they can be permanently anchored to the land on either side. And they can have similar environmental impacts to hydroelectric river dams.**

**Tidal stream devices, which you and I know better as tidal turbines generally have far lower installation costs, much greater flexibility of location and are way less impactful on the local environment and ecology. As a result, especially in more recent years, far more investment and development has been focussed on tidal turbines than tidal barrages. But unlike wind turbines, where the classic three bladed design has been fairly widely accepted as the most efficient configuration, especially at larger scale, there are still lots of different designs for tidal turbines, all vying for supremacy in what is still a relatively young but potentially very lucrative industry.**

**This latest design is called the O2 tidal turbine. It’s the product of fifteen years of continuous development from an Orkney based engineering company called Orbital Marine Power.**

**It was built by at the Forth Ports quayside facility in Dundee, Scotland and towed out on the twenty second of April, arriving two days later at an interim commissioning location at Deer Sound where it’ll undergo final testing and tow trials before being taken to its final location at the European Marine Energy Centre or EMEC, in the Fall of Warness in Orkney.**

**In a recent BBC interview Orbital’s Chief Executive, Andrew Scott pointed out that Orkney was an ideal location to host the new turbine, not just because that’s where the company headquarters are located, but also because Orkney sits in some of the strongest currents in the world, with sea conditions that can get fairly ferocious. That makes it an ideal location to test and develop these sorts of technologies, which will ultimately have to stand the test of time in some of the most unforgiving environments on earth.**

**It’s not the first machine from Orbital to arrive at EMEC either. Two previous versions have been tested there, the most recent of which was a full-scale prototype called the SR2000 which was put through its paces between twenty sixteen and twenty eighteen. That trial delivered record breaking results, as well as vital test data and operational experience that laid the ground work for this latest commercial scale evolution of the design concept.**

**When it’s fully operational, the O2 turbine will have a generating capacity of two megawatts - enough to power two thousand homes.**

**The structure is made up of a six hundred and eighty tonne floating hull measuring seventy-two metres, or two hundred and thirty-six feet in length. That’s about the same size as a jumbo jet. Inside the hull is all the electrical equipment to power the various systems.**

**Attached to the sides of the hull are two eighteen-metre long pivoting arms, each one supporting a twenty metre rotor with a sweep of six hundred square metres.**

**The whole thing is held down to the seabed with a four-point mooring system using some pretty serious chains – each one capable of suspending more than fifty double decker buses.**

**According to Orbital, about fifty percent of the power available in the water column comes from the top third, and the currents in Orkney can get up to 4 metres per second, so those rotors are well placed to capture the full force of that tide to generate power.**

**One of the smart innovations with this system is that the pitch of the blades themselves can be reversed between tides so that they can rotate whichever way the water is flowing.**

**Electricity is transferred from the turbine via a dynamic cable to the seabed and then through a static cable to the local onshore electricity network.**

**And thanks to another piece of very clever design, the rotor support arms can be lifted out of the water in a sort of gull wing motion by a hydraulic-actuated linkage system. That makes the whole thing much easier to tow using relatively small and inexpensive tug boats, and it also minimises the complication and cost of maintenance and repair.**

**In fact, that low-cost simplicity was one of the key objectives of the project. According to Scott, as a very rough comparison, if the cost of any given maintenance job onshore is, say, a dollar, then that same job could cost more like a hundred dollars in an offshore location at the surface and perhaps as much as ten thousand dollars at the bottom of the seabed. So, investing in a very sophisticated hydraulic hinge system actually makes good business sense in the long run.**

**It’s probably a bit of a stretch to refer to a six hundred and eighty tonne superstructure as a plug and play system, but there really is not much more to the installation than towing the rig to site, connecting up the chains and electrical cable and pressing the ‘go’ button. There’s none of the huge civil engineering works or CO2 hungry concrete support structure or dams that you get with tidal barrages.**

**Orbital are now moving full steam ahead on the commercialisation of the design, and are seeking market support to enable them to build and install multiple units right around the UK coastline and potentially beyond that as well.**

**Just like any other sustainable technology, tidal power on it’s own can’t solve all the problems we face as a result of the climate emergency, but turbines like these could play a very important role in complementing existing wind and solar installations as part of the overall strategy to help the UK to achieve it’s commitment to reach net zero no later than 2050. Eighty percent of the materials are UK sourced and there’ll be an obvious boost to local employment through the long term operation of the turbines, which means as well as seizing an opportunity to become a world leader in tidal technology, Orbital will also be playing their part in supporting the UK’s green recovery.**

**And just last week, The Perpetuus Tidal Energy Centre on the Isle of Wight, right at the other end of the United Kingdom, announced that they’ve now gained offshore consents to place tidal turbines in the surrounding waters and signed an agreement with Orbital as part of a target deployment of fifteen megawatts of tidal power by twenty twenty-five. That’s potentially enough to run fourteen thousand homes.**

**On the global stage there’s an estimated capacity of about a hundred gigawatts available for tidal energy harvesting. That’s enough to power eighty million homes. If that potential was fully deployed, then Orbital reckon it would represent an investment in equipment and services of about four hundred and thirty billion dollars, not to mention the raft of jobs around the world that the infrastructure would create.**

**Now, as I mentioned earlier, I should make clear that other flavours of tidal turbine are available, but Orbital look like they’ve solved a great many of the problems that have beset previous attempts at large scale tidal turbines, and this O2 floating rig may just have set a new benchmark for marine power generation.**

**If you’ve got views on tidal power in general, or if you work in the industry, and maybe even have direct experience working on this project, then I’d love to hear from you in the comments section below.**

**That’s it for this week though.**

**A big thank you, as always, to the people who make these videos possible by supporting my work via Patreon. They allow me to remain completely independent, and they enable me to keep all my videos completely ad free, which means you’re not bombarded with commercials for all sorts of stuff that you don’t really need, and I must just give a quick shout out to the folks who’ve joined since last time with pledges of ten dollars or more a month.**

**They are**

**Fred Pratt**

**Hope Rohuovi**

**Ernst Duvert**

**Rob Kwikkers**

**Andy Bochman**

**Timothy Kerssen**

**William Toffey**

**Peter Cope**

**Matthew Wehrle**

**And**

**Artur Emanuel Kawa**

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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.**