**A few weeks ago, I posted a video about redox flow batteries, highlighting some of the most promising up and coming competitors in the global market place. It proved to be a subject that many of you good folks out there were quite interested in. So much so that I was somewhat inundated with comments about OTHER commercial redox flow battery manufacturers that I’d failed to mention, with one or two folks suggesting that I must either be blind or stupid. And for the record, it’s just a little bit of both.**

**So, thank you for your feedback, it’s always, ALWAYS a pleasure to receive constructive criticism. It never rankles and it helps become a better person… I’m not reading that..!**

**So, in this week’s video I will attempt to remedy my previous omissions and I’ll be taking a look at one particular company that reckon they can do the whole redox flow thing at a fraction of the price and with several other significant advantages, essentially by replacing solutions of Vanadium with nothing more exotic than good old-fashioned iron.**

**You’re welcome…**

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

**So, let’s talk about all those other companies right from the get-go, shall we? Just to manage your expectations a little though – this is not going to be a comprehensive list of EVERY SINGLE redox flow battery maker in the world, however large or small, because that would be a very dull video, and having delved into the global market a bit more deeply for this week’s video, I’ve realised there’s bloody hundreds of ‘em. China’s got an entire top ten list all of its own for example, including Ronke Power who I mentioned last time – they’re the ones who’ve just completed the largest vanadium flow battery system in the world at a whopping four hundred megawatt hours, providing enough juice to run two hundred thousand homes in Dalian, North West China, for an entire day. It’s also probably worth mentioning another Chinese outfit called V-liquid who make these one-hundred kilowatt, two-hundred-and-fifty kilowatt-hour assemblies that fit neatly inside twenty-foot shipping containers and can be connected in series and parallel in a modular way to produce systems that can reach a hundred megawatt-hours or more.**

**I also mentioned the Enerflow system from H2 in South Korea last time, but I missed out a MASSIVE industrial conglomerate over here in Japan that you may well have heard of : they’re called Sumitomo Electric Industries Ltd. THEY started developing redox flow batteries as far back as nineteen-eighty-five, and have been successfully implementing projects all over the world since two thousand and one, ranging from very large scale installations for national grid operators in Japan and the US, to smaller microgrid solutions in Africa, Asia and Europe.**

**Speaking of Europe, the Austrian firm Cell Cube, who I did mention last time, have some competition from a number of European manufacturers. The Schmid Group next door in Germany has partnered up with Saudi industrial group SABIC to develop a vanadium flow system that they call Everflow, not to be confused with the Enerflow system from H2 that I just mentioned.**

**Are you with me so far?**

**Schmid’s Everflow technology can provide solutions for virtually any application from a stand alone five-kilowatt system with six hours of continuous discharge, right up to very large utility scale installations.**

**Then there’s Volt Storage, founded in Munich in twenty-sixteen. They recently secured thirty million dollars of venture capital from the European Investment Bank to develop a range of vanadium flow battery products for commercial and AGRICULTURAL applications with the very laudable stated aim of ‘making one hundred percent renewable energy available twenty-four / seven.”**

**A fourth European option is Prolux Solutions, based in Switzerland. They’ve been going since the nineteen-nineties, and they make a redox flow system called STORAC, designed to fit into domestic houses. So, in theory folks, you too could soon be enjoying the great taste of Vanadium in the comfort of your own home, sometime very soon!**

**Meanwhile, across the pond in North America, Invinity Energy Systems, who I spoke about last time, ALSO have competition from several notable challengers. The first is Largo Inc. based in Ontario, Canada. They’ve been digging up their own raw materials at their Maracas Menchen mine in Brazil since nineteen-eight-eight to supply high grade vanadium pentoxide flakes and powder to be used as catalysts and as alloys in the steel industry. More recently they bought up a bunch of battery patents from another US outfit called VionX Energy, so that they could start manufacturing their own flow batteries to get themselves a share of what they recognise as a rapidly expanding and potentially very lucrative energy storage sector.**

**Primus Power Solutions based in Hayward, California have a commercial and industrial scale product called EnergyPod2 based on a zinc-bromine redox flow chemistry, not dissimilar to the technology from Redflow in Australia that we looked at last time. And then there’s the mighty Lockheed Martin, which is a name you’re probably familiar with in the context of the advanced technology they supply to the US military for electronic warfare and integrated air and missile defence systems. Well apparently, they also make stuff that doesn’t help kill thousands of people all over the world.** **Their GridStar Flow product is a vanadium-based system optimised for six hours or more of flexible discharge in large scale transmission and distribution, peaker plant replacement, and bulk shifting of renewable energy. In twenty-twenty-two they were awarded a contract to build the first megawatt-scale, long-duration energy storage system for the U.S. Department of Defence, to be installed at Fort Carson, Colorado for the U.S. Army. So maybe I spoke too soon?**

**Anyway, all of that, I think, shows us that redox flow technology is not some flash in the pan, unworkable, pie in the sky idea. It’s a proper working technology that has an awful lot of very attractive selling points for commercial, industrial, utility scale and even domestic consumers. Which brings us nicely to that iron flow battery maker that I alluded to at the start of the video. No doubt many of you will have already heard of them. They’re called ESS Inc. and they’ve been operating out of Wilsonville, Oregon since twenty-eleven.**

**The basic flow mechanics are essentially the same, it’s just the solutions that are different. As the system charges up, Iron ions contained in a saturated salt water electrolyte gain an electron and deposit out as solid iron at the plating electrode on the left here. Once that process is complete the battery can be put to use in the discharge phase where electrons run through the electrical circuit to do some useful work. The solid iron then dissolves back into the salt water electrolyte. Essentially you can keep doing this time after time almost ad infinitum because there’s no deformation of electrodes or build up of dendrites like you get with many other battery types.**

**As well as less expensive and more abundant feedstocks, iron redox batteries also have a higher energy density than Vanadium Redox Flow batteries due to the higher solubility of iron ions in the electrolyte, allowing for a higher concentration of active materials, which means that they can store more energy in a given volume. The solutions are non-toxic and environmentally friendly, and the overall system has exactly the same easy operation and maintenance that characterizes all flow battery systems.**

Top of Form

**In September twenty-twenty-two, the US Department of Energy launched an initiative called ‘Storage Innovations Twenty-thirty with the stated aim of developing specific and quantifiable R&D pathways to achieve the targets identified in their** [**Long-Duration Storage Shot**](https://www.energy.gov/eere/long-duration-storage-shot)**, including a ninety percent cost reduction for technologies that can provide ten hours or longer duration of energy discharge by twenty-thirty. They’re aiming to achieve an industry levelised cost of storage or LCOS, of just five cents per kilowatt hour, which really would make an awful lot of objections disappear into the ether. Right now, the world’s major flow battery manufacturers, including most of those we’ve mentioned today, are fully engaged with the DOE to examine potential barriers for further development and to help identify the most promising R&D opportunities that can get them to that ambitious goal.**

**I must just mention another option gaining some traction too – it’s something called ORGANIC Redox Flow batteries which aim to replace all the scarce and environmentally harmful materials in standard Redox Flow batteries with more benign substances. It’d take too long to go into the details here, but I did take a look at these things in a video I made a couple of years ago, which I’ll link in the description section below, and in fact so much progress has been made with organic redox flow batteries since then that it warrants one of my increasingly regular review videos which you can catch on this channel next Sunday.**

**Now, despite my best efforts at proper grown up research for this week’s video I’m quite sure I will still have left out some companies that someone out there will be keen to tell me are the ‘next big thing’ in the redox flow battery market place so, if I have and if you think they deserve some attention, then let me know in the comments section below and I’ll go and take a look.**

**That’s it for this week though. A big thank you to the Patreon crew, as always, for helping me stay independent and keep ads and sponsorship messages out of my videos. And an extra special ‘thank you’ to the folks whose names are scrolling up the screen beside me here, all of whom celebrate an anniversary of Patreon support in September.**

**If you’d like to get involved with all that, then you can find out all about it at Patreon dot com forward slash just have a think.**

**And you can hugely support me right here on YouTube absolutely for free by subscribing and hitting that like button. It won’t cost you a penny to do that, but you really would be helping us massively, and you’d have my undying gratitude. It’s dead easy to do - you just need to click down there or on that icon there.**

**As always, thanks very much for watching! Have a great week, and**

**Remember to just have a think.**

**See you next week.**