**Gravity energy storage. Who's right and who's wrong??**

**Back in January last year I made a video looking at the concept of gravity energy storage. You may remember me showing you a group of design students who set up a nice little demo on a very high building that generated enough electrical energy to run a record turntable.**

**Clever stuff!**

**Back then I focussed on two companies who were developing their own different interpretations of gravity energy storage at utility grid scale. One of them was the Swiss based company Energy Vault, who’s massive open-air tower and multiple crane design got quite badly panned at the time by some well-known YouTube debunking channels.**

**The other company was an Edinburgh based outfit called Gravitricty. They were pursuing a very different road to achieving a gravity energy storage system, opting for a much safer, more stable and predictable system that involves lowering massive weights into decommissioned mineshafts.**

**Now, one of the requests I get quite often from you good folks out there is for me to occasionally revisit technologies that I’ve featured in past videos to check out what progress they’ve been making.**

**So, one year down the line from that original video, I thought now was as good a time as any to take another look.**

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

**This whole “using gravity to store energy” thing, is a pretty good idea in principle. In fact, we’ve effectively already been doing it for more than a hundred years with pumped hydro facilities that make use of reservoirs of water at different heights, pumping water uphill when power is available and letting it flow back downhill through a turbine when power is required. The trouble is, those facilities are quite expensive to build and of course you need the right geographical conditions to make them work, so they’re not something you can simply replicate all over the world.**

**Energy Vault’s original concept was this massive free standing tower, on top of which they planned to bolt about five cranes that could winch great thirty tonne weights up and down depending on whether there was a surplus or deficit of energy on the electricity grid. Now I’m not going to get into the weeds of why some commentators were so critical of this system, I’ll let you go and find those debunkers yourself on YouTube and other social media platforms. Suffice to say, there were some very significant questions of physics that appeared not to have been addressed, like the fact that all of the blocks at the bottom of the pile possessed precisely zero potential energy because they were already sitting on the floor, plus the perfectly reasonable observation that it would be quite tricky to stop a thirty-tonne weight wandering off the vertical on a windy day, which would not only mess up the synchronization of the system but would also put untold stresses and strains on the tower structure itself.**

**Energy Vault now appears to have moved away from that original design concept and pivoted towards this new idea, which they tell us is the Energy Vault Resiliency Centre, or EVRC. It’s a warehouse style building about the size of a very large football stadium housing hundreds of multi-storey racking systems carrying thirty tonne blocks in each location, all of which will, apparently, get lifted, dropped, and shunted from side to side by a complex network of computer- controlled pulleys and castors.**

**Now, that is a heck of a construction project! But Energy Vault aren’t stopping there. They reckon this facility is a modular design that can be built out into even larger configurations, presumably eventually reaching the size of small town!**

**Now of course this video was not filmed at a real-world construction site. It is in fact a computer-generated rendering of what such a football stadium sized facility would look like.**

**You can tell by the white blobby trees in the background.**

**Eh? Eh? – no flies on me mate!!**

**So, as far as I know, such a building has not yet been created anywhere in the world and Energy Vault are still at concept stage. I must admit, it does look like an awful lot of expensive infrastructure to support the loads involved, all of which would most likely require some serious regular maintenance over the long haul.**

**So, I think I’ll let you make your own mind up about this one, and maybe I’ll have another little rummage around at some point in twenty-twenty-three, to see if the company has actually broken ground anywhere in the world.**

**In the meantime, a very different company, with a very different approach to harnessing the advantages of a gravity energy storage system, is Gravitricity in Edinburgh, who I mentioned at the start of the video.**

**I caught up with their MD, Charlie Blair, via Zoom recently, to help with my understanding of how Gravitricity differs from Energy Vault and to get the latest news on how their concept is progressing.**

**Arguably the most fundamental difference between the two concepts is that Gravitricity believe that, outside of pumped hydro, the only serious way to achieve safe, reliable, dispatchable grid scale gravity energy storage, is to use the geology of the earth. One of the most compelling arguments for this approach is that instead of building a massive warehouse with miles and miles of steel support structures inside, you can simply use the planet to hold up your weights. After all, that’s precisely what a pumped hydro system does, isn’t it?**

**Now, just to really confuse the issue, the first demo structure that Gravitricity built back in 2021 was… a steel framed tower above ground! So, what was that all about then?**

**Well, Charlie explained that it was a simple matter of making things as simple as possible for the test rig so that all the mechanical elements could be easily monitored and viewed by the engineers.**

**The tower only needed to be quite small compared to a full-size configuration to . The rig was essentially built to assess the dynamic behaviour of the weight during the stop-start phases of the system, and specifically the speed of response that the system could achieve as gravity competed with inertia to get the weight moving. That sort of test data is absolutely crucial for any device providing grid frequency regulation. Engineering simulations showed that the system would operate within acceptable parameters, so the test rig was there to validate those results. And, happily for Gravitricity, validate them it did.**

**The concept demo used a naturally high-density iron ore aggregate derived from magnetite. At full scale, each weight will be around five hundred tonnes, so having it in lots of small pieces rather than one big solid lump obviously makes it infinitely more manageable for transport, as well as on-site handling and maintenance, and even for decommissioning at the end of a facility’s operational lifetime.**

**The winches and motor generator system that allow the weights to be gently lowered and raised work on very similar principles to the regen braking system in an electric vehicle, which harnesses the energy that would otherwise be wasted as the vehicle slows down or goes down a hill. Except of course in this case the energy is going directly into the grid rather than into a battery.**

**The core elements of the system, like the shaft and the weights, and the structural elements holding the winches and motor generators, all have projected operational lifetimes of more than fifty years. The cables are good for 75,000 cycles, which is about ten times the number of cycles that a typical battery can manage.**

**At full scale the shaft depth will be between 300 and 500 metres and the containers of iron ore will be between 3 and 5 metres in diameter and perhaps 4 or 5 metres deep.**

**The system is designed to be extremely versatile in terms of duration of discharge. It can be used for anything from instant response frequency regulation with a single weight system in an existing mineshaft, which is extremely useful in conjunction with intermittent sources like wind power, right up to long duration discharge times of between 2 and 8 hours in purpose built multiple weight configurations to compliment solar power and to provide extra electricity for peak hours of the day.**

**Now, the question many of you, quite rightly, ask me about any of the energy storage systems I look at on the channel is – what’s the levelised cost of storage, or LCOS. And the answer to that question is that it depends which variables and parameters you put into the calculation. Gravitricity commissioned Imperial College London to assess their system, and the parameters they input looked like this, for a storage system with a discharge time of two to six hours. For a 24.4 MWh system cycling 730 times a year for 25 years, the Gravitricity system stacks up very favourably indeed, not just against lithium-ion batteries, but also against a range of other energy storage options currently available.**

**The next step for Gravitricity will be to assess different locations all over the world to establish which ones are suitable for this kind of system. And there’ll be no shortage of options. The European Union is keen to accelerate coal mine closures as part of its REpowerEU initiative, and it obviously makes sense to look for ways to do something useful with those decommissioned facilities. In fact, Gravitricity is already in contact with mine owners in countries like the Czech Republic and Poland, and similar opportunities exist in North and South America and in Africa.**

**Having derived very positive data from their proof of concept tower up in Scotland, Gravitricity are now in the early stages of an eighteen-month engineering design phase for their first full size, fully operational facility. Once that work has been done and the location has been finalised, then there’ll be a further eighteen months of build time, which takes us to somewhere in 2025 or 2026. After that though, the turnaround time for subsequent projects is likely to be relatively quick.**

**So, there you have it, folks. A progress report as promised. I guess what it shows is that it’s bloody hard work to get from design concept to a real-world commercial operation. Gravitricity are a pretty pragmatic and realistic team of predominantly engineering types who understand that there are no shortcuts, and no amount of slick marketing will make the process move any faster. But their system does look like it could serve a very useful purpose in a very large number of otherwise useless and redundant locations all over the world. And if it can achieve that then it really will be offering a meaningful contribution to the sustainable energy transition.**

**Now, you’re probably chomping at the bit to voice your opinion on this one, so by all means jump down to the comments section below and leave you thoughts there. Keep it civil though, eh?**

**That’s it for this week.**

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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**