**If you’re a regular viewer of this channel then I imagine it hasn’t escaped your attention that our global energy markets appear to be entering a pretty disruptive period as the world transitions from fossil fuels like coal and gas to renewable technologies like solar, wind and batteries. From the energy suppliers’ point of view, there are huge challenges in meeting constantly changing demand with ever more unpredictable and extreme weather patterns and an ever-increasing percentage of intermittent power sources on the electricity grids. From the consumers point of view, that generally translates into ever increasing energy prices, or in extreme cases, like the 2021 winter storm in Texas or the gas supply crisis currently besetting Europe, it can also threaten the actual supply of power itself. Those challenges ARE, thankfully, temporary and fixable with a bit of foresight and strategic logistical planning.**

**But arguably a much more disruptive consequence of the transition is the long-term impact on families and communities whose livelihoods currently depend on the fossil fuel industry. Despite the rapid rise of renewables, two thirds of the world’s electricity still comes from fossil fuels today, and most of that is in the form of coal.**

**Most of those coal fired power plants will be retired over the next two decades as thousands of gigawatts of capacity is moved across to low carbon sources, much of which will be in the form of intermittent wind and solar plus a truly mind-boggling amount of energy storage capacity to keep the lights on when the wind isn’t blowing, and the sun isn’t shining.**

**That means all that valuable existing fossil fuel infrastructure will most likely just sit there decommissioned and redundant. What a shame we can’t re-use those enormous facilities in some way as part of the energy transition, and maybe even get some gainful employment back into those areas as a result.**

**Well maybe we can. In fact, that’s precisely what a European company called E2S Power is working on right now, and their technology could well be exactly what the world needs to give otherwise stranded assets a second life as part of our renewable energy future.**

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

**I’m sure E2S Power would be the first to admit that their plans for converting disused power plants are not simply an altruistic attempt to combat climate change and create a better world, although they’ll certainly be contributing to that goal. No, I think it’s fair to say that they’ve spotted a potentially lucrative gap in the market that they feel they can fill with their technology. According to their Director of Marketing and Business Development, Dr Carlos Haertel**

**“The extensive installed base of thermal power plants offers an enormous market opportunity for those who develop conversion solutions. The sheer scale of the required ramp-up of storage capacity will necessitate all storage options on the table to contribute to the challenge. No one technology or solution will be able to shoulder it alone.”**

**So, what’s their plan then?**

**Well, the E2S system will essentially remove the boilers from disused power plants. The boiler is where all the coal gets burned and all the CO2 emissions are produced. They’ll replace that element with their own purpose-built thermal energy storage system. The potential benefit of their system is that it’ll perform the same function as the old boilers did. In other words, it’ll heat up water to produce high pressure steam to run over a turbine and drive an electrical generator. That means that all the other infrastructure in the power plant can be reused, which if course means it will all need to be run and maintained, just like the old power plant was. And that means jobs for local workers. The main difference is that the plant will no longer be a power generation facility. It will simply store energy from renewable sources that can then be despatched when it’s needed.**

**There are of course lots of thermal energy storage solutions either in development or already in use in various parts of the world, and we’ve looked at one or two of them on this channel. The USP of this system though, according to E2S Power, is a novel thermal storage material class called Miscibility Gap Alloys or MGAs, developed and already being manufactured by their Australian partner company, MGA Thermal.**

**MGAs are a composite of graphite and aluminium and in the E2S system they’re assembled as sets of two solid thermal storage slabs or blocks, with the graphite providing a sort of outer matrix containing the aluminium inside. The slab sets are arranged in a storage module about the size of a shipping container which, for reasons best known to E2S, is called the Hamster.**

**Through the off-peak hours, the thermal battery is charged with surplus electricity from renewables, taken from the grid using existing step-up transformers. That runs electrical heaters that are specially designed to resist temperatures higher than a thousand degrees Celsius. They heat the first set of storage blocks to about seven hundred degrees Celsius. That’s higher than the melting point of aluminium, which is about six hundred and sixty degrees Celsius, but way lower than the melting point of graphite, which is around three thousand six hundred degrees Celsius.**

**So, the aluminium melts, or to use the proper science speak, it experiences a phase change from solid to liquid. And, if you watched my video about Arctic Sea ice last year, you’ll remember we looked at the latent heat required to persuade a material to transform from its solid state at melting temperature into its liquid state, still at melting temperature. And it’s a lot of extra energy! That means in the melting process the aluminium absorbs all that latent heat, which according to E2S is the main reason why their system can achieve a relatively high energy density. The graphite is well below its melting point, so its job is to keep the block solid and contain the melted aluminium. That’s a key advantage of the system, because from a user point of view it means there’s pretty much no extra manipulation or maintenance required.**

**Meanwhile the second set of storage blocks is heated to a slightly lower temperature – about five hundred and fifty degrees, which is the inlet temperature required by the existing steam turbine.**

**As with all thermal energy storage systems, insulation is a key component. The shipping container sized modules in this set up are not only extremely well insulated, but they’re also filled with nitrogen to protect against oxidation. That means they can hold onto their thermal energy for several days until it’s required.**

**To discharge the system, steam is initially generated in the first set of blocks at close to seven hundred degrees Celsius, before moving through the second set of blocks to be cooled down to the five-hundred and fifty degree temperature that the existing turbine equipment can accept.**

**E2S reckon the phase change heat storage in their MGA technology allows for very high efficiency with very similar simplicity and robustness of other systems that use materials like steel or concrete as storage elements. And it uses a lot less valuable space than those other storage media too. Steel would need three times the volume and concrete would need twenty times the volume to produce the same temperature level and energy content as the MGA system.**

**Graphite and aluminium are also extremely abundant, commonly used and non-toxic base materials. A fact that should go some way towards addressing the criticism often raised about environmental impacts, tight supply chains, and recyclability of the materials in many energy storage devices currently in use today.**

**And because it’s a modular ‘drop in’ system, it can be tailored to fit perfectly with whatever existing infrastructure each power plant currently has. The same voltage and current levels as the existing generators can be used to feed the electric heaters and the system can use the same high-voltage switchgear, existing steam turbines, and all the other plant like condensers, cooling towers, heat sinks, generators, and transformers.**

**E2S say they’ve validated their technology in a demonstration facility in Belgrade, providing valuable data on the storage properties, materials selections and steam generating capabilities of the system. Precise figures aren’t yet available, but E2S confidently claim their thermal storage system can generate similar levels of steam to those achieved by the original coal powered boilers that they’re replacing.**

**They’re already working with major power utilities in Europe on a fifty-megawatt hour pilot that’ll be integrated into an existing operating plant in 2022. That should pave the way for commercial scale expansion the following year. If that all proves successful, then potentially there’s scope for a global roll out over the coming decade as more and more coal fired power plants are retired around the world.**

**Just like some of the other energy storage solutions we’ve looked at in recent videos, the E2S system is designed to work alongside Lithium-ion batteries rather than compete with them. The target application for a converted thermal plant is balancing variations in load and supply over an entire twenty-four hour period, or even over several days.**

**E2S aren’t the only organisation to have used a bit of lateral thinking to make good use of otherwise stranded assets though. Siemens Gamesa has a system called Electric Thermal Energy Storage or ETES, which we’ll take a look at in a future video. And several other energy industry giants are all looking for innovative ways to make good use of existing infrastructure.**

**No doubt there are lots of other smart applications designed to make good sustainable use of decommissioned infrastructure that I haven’t mentioned here, so if you’ve got your eye on one, or if you’re actually working with one of these new technologies, then why not jump down to the comments section below and leave 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**

**William F. Bergmann**

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**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.**