This New Technology Could Change the Power Storage Game.

Retrieved Wednesday 11th of October 2017 08:13:00 PM

Yesterday, I had the embarrassment of having to grovel for one of the worst mistakes I've ever made at *Exponential Investor*. I'd overlooked a *huge* energy story – wrongly dismissing it as a niche market.

That technology is capacitors. If you're unfamiliar with these, do take a look at yesterday's article.

Capacitors are widely used in all kinds of electrical and electronic devices. They're even used for energy storage, in certain specialised applications – such as buses.

Today, we're going to look at how they can be used for energy storage, on a huge scale. We'll also look at some of the ground-breaking firms, which are driving capacitor technology to new heights.

If you want to store grid electricity, you can stack up vast arrays of capacitors. This provides fast-response electricity storage. That's great for controlling unpredictable spikes in energy demand – which could otherwise seriously destabilise the grid. One firm exploring this approach is Maxwell Technologies. The firm makes capacitor banks, to help tidy up the power output from wind farms. John Miller, from Case Western Reserve University, has even explored filling derelict power stations with them. That location idea is sensible – because the transmissions lines and switchgear are already built.

But there's been a recent game-changer – which could revolutionise our whole approach to energy storage.

Let's take a quick look at the physics. The higher the surface area of a capacitor's plates, and the closer they are together, the more energy a capacitor can store. This naturally leads us to nanotechnology, as an approach.

Writing in *ACS Nano*, Nitin Choudhary and his team from the University of Central Florida have reported a breakthrough in capacitor miniaturisation. Their design, based on nanowires, has made the plates as small as they can possibly be (based on the limits of current materials). The device structure now resembles a microscopic hairbrush, with each of the bristles being a combination of plates. As such, the surface area is absolutely enormous.

It's a game-changer for capacitor technology.

Media attention has understandably been focused on whether capacitors could now be poised to take on batteries. The performance stats certainly look promising. Quoted in Science Daily, Choudhary said, "you could charge your mobile phone in a few seconds and you wouldn't need to charge it again for over a week." What's more, the device should last for 30,000 charging cycles. That means it will be nearly 700 years before you'll need to replace your smartphone battery – although the materials would probably break down for other reasons, before then.

If this technology makes it to production at a reasonable cost, it will unlock not only smarter smartphones, but also trigger an energy storage revolution. This will mean we could have everything from electric aircraft, to compact home electricity storage – not forgetting long-range electric vehicles.

Along with inexpensive photovoltaics for solar power, nanotech capacitors could therefore be the technology that powers the 21st century.

But it's not the only promising approach – and there are a host of other teams, working in this space.

For example, Skeleton Technologies is focused on using graphene – and not the plant-based kind its competitors prefer. The firm has taken some decent investment – and has current customers in motorsport, aerospace, and short-duration energy storage. This means it's a company that's worth a close look. Our previous coverage of this subject gives background information.

Augmented Optics (better known as its Supercapacitor Materials subsidiary) has another approach – based on an improved electrolyte (a material that acts as one of the conductive plates). That means it can become a supplier to other capacitor companies. Its team comes from ITM Power; an impressive company, which we've briefly mentioned in yesterday's article – among others. It's hard to get clear data on its performance improvement, as the firm's website quotes contradictory sources. However, it's

at least 10x better than conventional supercapacitors. That makes this firm another potentially serious challenger to battery technology.

Finally, there's another very cool idea – to get the "best of both worlds". This involves combining the high power of a capacitor, with the high capacity of a battery. Of course, you can do this by simply wiring the two of them together (we touched on this yesterday). But this new approach is far smarter. It involves creating a single device, which behaves as both a capacitor and a battery. Eléonore Mourad together with fellow researchers announced this novel approach late last year – in *Nature Materials*. If they can commercialise this, the technology could be a game-changer for power storage.

This is a busy landscape of firms, each with bold claims and radical technologies. It's going to be tough to pick a winner – but I'm definitely bullish about the sector overall.

Your feedback is always welcome: andrew@southbankresearch.com.

Best,

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