**‘NASAs new solid state battery smashes Tesla 4860 on energy density’**

**If you’ve been keeping even a cursory eye on the sustainable energy market over the past few years you surely can’t fail to have noticed that there has been an awful lot of hype about the apparently ‘game changing’ technology of solid-state batteries.**

**We first looked at them on this channel back in twenty eighteen, and at that time there were very high hopes we’d see these lightweight, high energy density units powering mass produced electric vehicles by about now. But it hasn’t happened yet, has it? At least not at anything like the scale envisaged back then.**

**Now, I grant you, we did all get a little bit interrupted by a global pandemic during twenty-twenty and part of twenty-twenty-one, but nevertheless, all we’ve really had so far is an awful lot of promises, and an awful lot of hope to go along with the hype.**

**And here we are in November twenty-twenty-two, with news that the folks at NASA have decided to wade into the fray with their own solid-state energy storage system that they reckon has almost twice the energy density of Tesla’s latest 4680 lithium-ion battery.**

**So just what is going on here? Are we all just being strung along with yet another ‘never-never’ technology, a bit like the notorious Nuclear Fusion, or are we actually on the cusp of a major leap forward in automotive history?**

**Well, let’s see if we can make some sense of it all.**

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

**It’s not hard to see why so many developers are racing to perfect a solid-state battery that could replace current lithium-ion technology.**

**In theory, solid state batteries are a far better solution to the problem of storing as much energy as possible, for as long as possible, with total safety but also instant deliverability.**

**The solid electrolyte takes up far less space than the liquid version found in existing lithium-ion batteries. That makes the whole thing much more compact, with a much higher energy density, potentially as much as three times that of a standard lithium-ion battery. Solid-state batteries can work at very high rates of power as well. Research suggests that they may be capable of recharging up to six times faster than current technologies and achieve far more charging cycles during their useful working life – something that electric vehicle makers are particularly interested in for obvious reasons.   And because they don’t have a volatile and highly flammable liquid electrolyte, they no longer need the cumbersome battery management systems that add weight and cost to existing lithium-ion batteries.**

**But for various reasons it’s proven to be devilishly difficult to achieve all those fantastic properties, all at the same time in the same battery on a mass-produced scale in the real world.**

**So, nailing the solid-state battery conundrum remains an enticing technical challenge for the science bods to get sink their teeth into. If they do manage to iron out all the wrinkles though, and get these things into the mainstream of automotive production, and quite possibly all sorts of other energy hungry applications, then it’ll be a major step change for those industries.**

**A recent report by market analysts Straits Research projected that the market for existing solid-state batteries, which are currently used in a few niche applications OUTSIDE of the automotive industry, is set to rise from about eight hundred million dollars a year today to just over two billion dollars a year by 2030. But if solid state batteries COULD BE commercialised for EVs in the next couple of years then that projection shoots up to more than thirteen billon dollars by the end of the decade.**

**And there are some pretty big names in the mix, including industry behemoths like Bosch and Toyota as well as specialists whose names may be very familiar to you, like QuantumScape, Prologium and Solid Power.**

**So, I suppose the obvious question has to be - what makes NASA think they can muscle in on an already very competitive space?**

**Well, it turns out NASA has actually been working on the solid-state battery challenge for several years, as part of what it calls its Convergent Aeronautics Solutions project for sustainable aviation. And in keeping with our modern predilection for snappy acronyms, NASA’s battery project has been given the title of SABERS, which stands for Solid-State Architecture Batteries for Enhanced Rechargeability and Safety.**

**The initial focus of the project was to provide electric power for vertical take-off and landing vehicles, or eVTOLs, which some believe may well turn out to be the urban air mobility solutions of the near future.**

**Developing an energy storage system that can meet the rigorous safety and performance criteria of the aerospace industry is a huge challenge. NASA’s own preliminary systems level analysis kicked up five key properties that’ll have to be optimized for any successful implementation of airborne battery systems. [safety, energy density, power, packaging design and scalability].**

**The best EV batteries available today could probably meet the power and scalability requirements but they don’t quite cut it when it comes to energy, safety or packaging design.**

**According to their own publicity, which we’ll just have to take at face value for the purposes of this video, NASA reckon their SABERS concept meets all five key performance criteria with a solid-state architecture that uses a high energy density and high-power density sulphur-selenium cathode in conjunction with a lithium metal anode.**

**That combination apparently optimises the energy-to-power density ratio, which NASA says can then be tailored to each specific application. The cathode uses a patented NASA technology called “holey graphene technology”. That’s ‘holey’ with an ‘e’, as opposed to some kind of divine manna from heaven. NASA’s holey graphene provides a highly conductive, ultra-lightweight electrode scaffold.**

**The two electrodes sit either side of a solid-state electrolyte which is a safe, non-flammable alternative to the highly flammable liquid organic electrolytes currently used in lithium-ion batteries.**

**Self- combustion of lithium-ion batteries is rare, but it can happen. If it’s the phone in your pocket, or even the battery pack in your electric vehicle, it may be quite a shock, but you’ve still got a decent chance of reaching safety while you watch your beloved investment burn to a crisp.**

**You don’t have that option in a plane though, do you? Unless you took the precaution of wearing a parachute for the entire flight. So, if we really want to see electric aircraft shuttling us across town or even on short haul flights between states or neighbouring countries, then solid state batteries are currently the only realistic option on the table.**

**But WEIGHT REDUCTION is ALSO a major consideration, for very obvious gravitational reasons. Holey graphene goes a long way towards achieving that goal,but NASA have also added a second very significant design improvement, which they call a bi-polar stack.**

**Instead of housing each individual battery cell inside its own steel casing, as liquid electrolyte lithium-ion batteries do, all the cells in NASA’s battery can be stacked vertically inside one casing. That not only keeps the weight down, but it also reduces the number of interfaced connections for each cell and minimises the cooling requirements.**

**The result is an overall battery that’s about forty percent lighter than existing lithium-ion technology with an energy density of 500 watt-hours per kilogram.**

**To put that into context, Tesla's 4680 batteries have an energy density of less than three hundred watt hours per kilogram, and the latest lithium iron phosphate batteries from the Chinese battery giant CATL are rated at a hundred and sixty watt hours per kilogram.**

**The NASA SABERS team has put this new battery through some rigorous testing to demonstrate its ability to operate in temperatures between zero and a hundred and fifty degrees Celsius, which is a fairly significant improvement on current technology.**

**During the past year, the SABERs team say they have successfully increased their battery’s discharge rate too – initially by a factor of 10 – and then by another factor of 5. That’s yet another important consideration for any prospective aviation battery or EV battery for that matter. And because it’s a solid-state battery it has an inherently long-life time with relatively little capacity degradation.**

**What we’re missing from the NASA SABERs PR bumf is any indication of charge time and, perhaps most importantly, any idea of cost.**

**Nevertheless, NASA’s principal investigator for the SABERS project, Rocco Viggiano, said
So, they’re clearly cockahoop about their new technology.**

**But, as usual, it’s not yet being produced at commercial scale, and probably won’t be for several years.**

**So, what about the rest of the bunch?**

**Well, It’s certainly a busy field of play, that’s for sure.**

**Toyota are leading the way, with more than thirteen hundred design patents, followed by Panasonic who have registered a further four hundred and forty-five. In twenty-twenty-one, they teamed up to gave us a fleeting glimpse of what appears to be a solid-state battery prototype EV, with full production slated for twenty-twenty-five.**

**Honda has hooked up with LG and invested four point four billion dollars in a US based battery plant which will come online in twenty-twenty-four to potentially provide power for their EVs by the latter half of the decade.**

**Nissan recently announced their own prototype solid state battery production facility with a goal of bringing a vehicle into full production by twenty-twenty eight.**

**QuantumScape has bagged more than three hundred million dollars from Volkswagen to develop what they regard as a market beating solid-state technology that contains a solid ceramic electrolyte and no anode at all, which they say overcomes many of the problems experienced by competing solid state battery designs. They’ve also now struck a deal with the German and US-owned energy company Fluence to develop solid state batteries for stationary storage applications.**

**BMW and Ford are backing the Colorado based start-up, Solid Power, who specialise in sulphide based solid state batteries. Solid Power has now finished installing a pilot production line at their Louisville factory that’ll supply batteries by the end of twenty-twenty-two for the automakers to begin testing.**

**Mercedes-Benz has chosen the Taiwanese solid state battery start-up Prologium to develop prototype batteries for its EV range. Prologium plans to launch its first three-gigawatt-hour production plant in early in twenty-twenty-three and Mercedes hope to get the new batteries into their vehicles by twenty-twenty-five.**

**It's impossible to delve deeply into the pros and cons of each of these technologies in a single video, but there is one common denominator that unites them, and that’s the cost of all solid state batteries, which is currently way higher than existing lithium-ion technology. Most significantly, replacing a cheap graphite anode with lithium metal will not only be expensive but also quite challenging from a resources point of view. Silicon may well prove to be an alternative though, and there are other possibilities currently in development in various labs around the world.**

**Meanwhile, the market leader in all things EV, Tesla Motors, seems to have pinned their future production plans firmly on their 4680 lithium-ion battery, and the world’s largest EV battery maker, CATL in China, reckons it’ll be at least twenty-thirty before we see solid state batteries in ANY mass-produced electric road vehicles.**

**So right now, the future looks about as clear as mud. I think it’s probably safe to say we’ll see solid state batteries come into commercial reality long before the other “never-never” technology of nuclear fusion, but that’s not setting the bar awfully high is it? Right now though, the hype is probably a little premature, so I’ll be taking any ‘revolutionary, game-changing, breakthrough’ technology pronouncement with a heavy pinch of salt for a little while yet!**

 **But what’s your view on where we’re at with solid state batteries. Do you think the market analysts have got their twenty thirty growth projections about right, or do you think it’s more likely we won’t see these things even START to come onto the mass market until next the decade.**

**As always, leave your thoughts in the comments section below and I’ll be interested to see what the consensus is.**

**That’s it for this week though. If you’ve enjoyed this video, then please do consider subscribing to the channel and hitting the notification bell if you haven’t already done so. That way you won’t miss out on future weekly content and you get the warm glow of knowing you’ve helped improve our channel’s chances of getting noticed by YouTubes algorithms.**

**Thanks, as always to our amazing Patreon supporters who guide that content and help me keep the channel completely independent, and I must just give a quick shout out to some folks who joined recently with pledges of ten dollars or more a month. They are**

**Andrew Bowen**

**Brian Mustain**

**Clifford Ireland**

**Santeri Soininen**

**Alex Trickey**

**Michael Johnston**

**Thom McDonald**

**And**

**William Graham**

**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**