**Back in twenty-seventeen a couple of youngish billionaires got themselves into a bit of an exchange on social media about battery energy storage.**

**One of the billionaires was the Australian entrepreneur Mike Cannon Brookes, and the other one was, of course, Elon Musk. We all know the outcome, don’t we? It was the 100-megawatt Tesla lithium-ion battery installation at the Hornsdale Power Reserve – shipped, installed and commissioned within a hundred days.**

**The Australian Prime Minister at the time derided it as a pointless gimmick, but it turns out that would have been a better description of himself than the big battery because the installation is reckoned to have saved South Australia an estimated one hundred million US dollars in grid balancing costs in its first three years of operation and is now fifty percent larger and routinely providing crucial inertia services to the state’s grid system.**

**In the year the Tesla Battery was installed, the world’s largest energy storage medium by far was pumped hydro, with about a hundred and fifty gigawatts of capacity– a position that looked pretty much unassailable.**

**But things have changed a bit since then, haven’t they?**

**While global pumped hydro capacity has grown to almost two hundred Gigawatts in twenty-twenty-four, utility scale battery energy storage has rocketed up from almost zero to more than a hundred and fifty gigawatts in the same timescale, and the trajectory of travel looks set to move the technology ahead of Pumped Hydro at some point in twenty-twenty-five.**

**Nowhere is that rise being more keenly felt than in the United States. Largely as a result of the Inflation Reduction Act, we could be looking at more than forty gigawatts of grid scale battery energy storage in that country by the end of next year. So, are we finally seeing a quiet revolution on America's tired old grid system?**

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

**If you live in a US state other than California, then you’re probably a bit sick of hearing how the Golden State is ‘leading the way’ on solar power.**

**I get one of these sorts of charts in my face on social media just about every day now, showing me how Californian sunshine makes up the vast majority of daytime electricity generation. It’s the famous duck curve that I’ve talked about a couple of times in recent videos. But even that chart has been changing rapidly over just the last three years or so. Hydro has continued to grow, but the biggest difference is this astonishing increase in battery energy storage from pretty much zero in twenty-twenty-one to something like ten gigawatts today, displacing almost half of the gas demand that used to sit there between about 7pm and 10pm when most folks get back from work and start consuming energy at home. In fact, according to Bloomberg NEF, since twenty-twenty, California has apparently installed more utility-scale battery energy storage than anywhere else on the planet outside China.**

**The good folks a bit further East in the Lone Star state would claim a similar level of advancement though, and with some justification. Texas is obviously best known around the world for its prodigious production of oil and gas, thanks to striking it lucky with the seventy-five thousand square mile Permian Basin.**

**But they’re also by some margin the largest wind power generator in the union and they’re quickly catching California up on solar PV as well. The Texas grid operator ERCOT has recognised the way that utility scale battery energy storage can facilitate the implementation of intermittent renewables, so they too have ramped up the battery installs.**

**According to the US Energy Information Administration, or EIA, Texas now has more than a couple of dozen installations of ten megawatts or more, another half dozen or so topping a hundred megawatts and several pushing up towards three hundred megawatts or more. Something that would have been regraded as pure fantasy just a few years ago.**

**And we all know the main reason why, don’t we? It’s the absolutely astonishing improvements in battery technology coupled with a precipitous drop in prices in recent years that look at bit like a boulder dropping off a cliff when they’re plotted onto a chart.**

**In the US all of that has really been turbocharged by President Biden’s Inflation Reduction Act, which now applies attractive tax credits to battery storage installations.**

**And as more and more batteries have been deployed, grid operators have come to realise that they’re not some kind of annoying bolt-on that they have to suffer in order to get renewables onto their systems and tick their decarbonisation target boxes. They’re actually an extremely useful addition that can stabilize transmission frequency, reduce the reliance on expensive gas peaker plants during peak periods and prevent brownouts and blackouts in emergency situations like heat waves and wildfires. Power companies have also realised that they can fill up their batteries during off peak hours when generation is cheap or even price-negative and then sell those stored electrons back onto the grid at busier times of day when prices are higher.**

**In California for example, that means charging up in the middle of the day, when there is often more solar power available than the state can use, and then discharging them during the peak evening hours. It’s a system the industry bods call ‘arbitrage’.**

**And that brings us to a fairly major caveat, at least for those of us of a ‘climate emergency’ type of disposition. Because it highlights the different motivations for getting these contraptions rolled out at pace. No doubt some operators have the noble aim of reducing greenhouse gas emissions to make the world liveable for their grandchildren, but the reality in our market-driven world is that other, less scrupulous power producers are really only driven by the bottom line, and in some cases might actually be doing more harm than good, at least at the moment anyway.**

**This twenty-twenty-three study by the New York clean energy firm Tierra Climate took a look at the Texas ERCOT battery fleet to assess how effectively it was helping to decarbonise the grid. It found significant variations depending on where the battery installation was located. The one hundred megawatt, one-hundred and seventy-five megawatt-hour ‘Gambit’ facility, just outside Houston for example, is not coupled up with a wind or solar farm and has very limited opportunity to charge from low carbon sources. So, it mostly charges up from coal or gas fired power plants.**

**That arbitrage system I mention just now makes this a very profitable venture. In fact, it’s the most profitable battery installation in the state.**

**But it’s also the most carbon heavy, with most of its discharge producing what’s known as a Locational Marginal Emissions rate, or LME, of about half a metric ton of CO2 per megawatt hour.**

**By contrast, the nine-point-nine-megawatt, forty-two megawatt-hour, Castle Gap facility in West Texas is paired with a one-hundred and eighty-megawatt capacity solar installation and you can see from its chart that there’s much more opportunity here to produce energy with lower CO2 emissions.**

**The paper’s authors set out the entire ERCOT battery fleet and crunched some numbers to work out the potential carbon impact if a price had to be paid for carbon emissions – a so-called ‘Carbon Contract’.**

**With no contract at all, like it is today, much of the good work done to reduce carbon emissions by solar, wind and batteries at this end is negated by the emissions of fossil fuel-based battery storage profiteering at this end.**

**And that’s annoying.**

**So, three carbon prices were considered – twenty dollars per ton of CO2, fifty dollars per ton and a hundred dollars.**

**Even at just twenty dollars per ton, the best facilities get even better and most of the marginal installations tip into the negative emissions territory.**

**Fifty dollars improves that situation still further, and by the time you’re hitting producers with a price of a hundred dollars per ton of carbon dioxide emitted, all but the very worst offenders have tipped negative.**

**Many analysts, often from the fossil fuel industry, will tell you that carbon pricing never works and all it will do is hike up prices for us consumers. But others point out that this argument is based on our current fossil fuel dominated system and that the way to avoid a carbon price on your emissions is not to send powerful lobbyists to state legislatures or to Congress in Washington with pockets full of cash to coerce spineless lawmakers into doing the wrong thing, but simply to accelerate the adoption of zero carbon generation sources like hydro, wind and solar to avoid producing any emissions in the first place. Wind and solar are now the cheapest form of electricity generation in almost every part of the world, and now that battery prices are rapidly accelerating downwards as well, it’s all staring to look like a bit of a no-brainer.**

**And just look at the size of the opportunity across the lower forty-eight states. Arizona and Georgia are apparently well on the case already with plans to install thousands of megawatts of utility scale battery storage in the coming few years, not least to manage the rapidly increasing demand from data centres and production facilities. Even the big ‘megawatt-scale’ battery storage systems can be installed in weeks rather than the months or years that it can take for other solutions like pumped hydro, so they really are becoming an extremely convenient ‘drop-in’ solution from many grid operators.**

**That’s not to say they’re a silver bullet solution all on their own though of course, nothing is. They can’t do everything, and operators will certainly need more pumped hydro and other longer duration energy storage solutions, plus things like hydroelectric power where its available and most likely a greater amount of geothermal energy to get to a one-hundred percent decarbonised grids, but there’s little doubt now that batteries can and will play a major role in the mix.**

**Over here in Europe there seems to be a similar concerted effort to get with the program.**

**According to this chart based on data from the energy transition consultants LCP Delta, we’re up to about thirty-five gigawatts of cumulative capacity so far and we’re projected to reach more than a hundred and twenty gigawatts by the end of this decade.**

**And there’s a big push to ramp up production locally too rather than relying on imports from our friends in the Far East.**

**Analysis by the Argonne National Laboratory and data analysts Minviro shows that making batteries in Europe using predominantly renewable energy could result in a sixty-two percent reduction in production emissions.**

**In Australia, where the original BIG BATTERY arguably started the whole thing off, twenty-twenty-three was a record year for battery storage with two-point-five gigawatts of new capacity installed, driven largely by government tenders and Australia’s Capacity Investment Scheme or CIS . There are now more than six gigawatts of total cumulative utility scale battery capacity across the nation and that number is set to rise to thirty-two gigawatts by twenty-thirty.**

**In a country with a population of just twenty-seven million!**

**According to market analysts Cushman and Wakefield,**

**China installed more than thirteen gigawatts of battery energy storage in twenty-twenty-two and now has a cumulative capacity of more than thirty gigawatts, with an expected compound annual growth rate, or CAGR, of forty-four percent running up to twenty-twenty-seven, taking total cumulative capacity to more than a hundred gigawatts.**

**So, it’s all to play for by the look of it, folks. I’m sure there are plenty of you who have strong views on this one and no doubt some of you are champing at the bit to point out a bunch of parameters or variables that I may have omitted from this brief little summary video. If that’s you, or if you just have general feedback or information that you want to share then, as always, the place to leave your thoughts is in the comments section below.**

**That’s it for this week though. A massive thank you to the channel’s Patreon supporters who help keep the channel completely independent and free of ads and sponsorship messages. 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 July. If you find these videos useful and informative and you feel like you could support the channel for about the price of a coffee each month, then why not pop over to patreon.dot.com forward slash just have a think to have a look at the exclusive benefits you can enjoy there.**

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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.**