**We’ve talked about energy storage quite a lot on this channel. We’ve looked at some of the different ways to store energy, from the obvious stuff like lithium ion batteries, to arguably less-tangible things like storage in hydrogen, through to new innovations like liquid air batteries. And there’s a whole host of other solutions in development all over the world.**

**Energy storage is the key to unlocking existing electricity grids and allowing renewable energy sources like wind, solar and hydro to bring about the decarbonisation of our global energy systems that we so desperately need.**

**Up until now though, in the vast majority of cases, grid operators have only been using these energy storage solutions as a bolt on to their existing infrastructure to help smooth out some of the temporary spikes in demand. They don’t provide the bulk of everyday electricity provision for our homes, factories and offices.**

**In most cases that means grids continue to generate the bulk of the day to day power from fossil fuels like coal and gas, or from nuclear energy, restricting the extent to which those pesky intermittent renewables have been able to replace them.**

**But that dynamic is beginning to change, and it’s changing fast. And it’s leading some commentators to suggest that we now stand on the brink of what they describe as an Energy Storage Revolution.**

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

**In very basic terms, electrical grids consist of three elements. Generation, Transmission and Distribution.**

**The most common way to generate grid scale power in the first place is to use flowing water or high-pressure steam to drive a turbine connected to an electrical generator. Generators by their nature deliver an oscillating or alternating current, which essentially means the current flows in waves as opposed to the continuous straight line or direct current that you get from things like batteries and solar panels.**

**So, our transmission systems use alternating current instead of direct current, which is why solar panels and batteries run through inverters that convert their Direct Current into Alternating Current to make them compatible.**

**The frequency of these waves of Alternating Current is about 60 cycles per second, or 60 hertz, in North America and parts of South America, and about 50 Hertz in most other parts of the world. That might seem like unnecessary information but there’s a reason I mention it which I’ll come back to in a minute.**

**Anyway, AC power has some useful advantages over DC power for a for wide area grids, the main one being that the voltage of AC supply can be stepped up or stepped down using transformers, which by their nature need a variable current in a coil of wires at one end to induce a secondary current in a coil of wires at the other end.**

**Without delving too much into it, if you have fewer winds in the copper coil at one end than the other end, then the voltage induced in that end will be lower. But that only works with alternating current. It doesn’t work with direct current.**

**Why is that useful?**

**Well because really huge voltages come out of the initial power generators and those voltages provide the push to allow currents to travel over the very long cross-country distances to each neighbourhood. So, transformers play a crucial role in stepping down the voltage to a local supply level and then down again into the 120 or 240 volts that we use in our homes.**

**Demand for electricity varies considerably throughout the day, and matching supply to that demand is one of the main challenges of the electricity grid operators.**

**Supply has to meet demand in real time. When you switch on your light at home, you’re effectively using electrical energy that was generated at a power station a few tenths of a second ago.**

**When everything was dominated by coal and gas, powerplants could be sped up or eased down somewhat to accommodate the increases and decreases in demand across the day, and the fly wheel effect on the generators meant their momentum could continue generating electricity for some time, which helped to smooth out the peaks and troughs. More expensive power plants, known as Peaker Plants, also exist on grid systems to help deal with large spikes – like in the evenings when everyone gets home.**

**And from the early nineteen eighties most grids have had demand response supply agreements in place with large industrial units and factories to shed power when there was a shortage. These large electricity users will shut down non-essential machinery on request in return for a nice juicy compensation payment from the grid operator, which in turn means the grid operators can keep the lights on for the rest of us.**

**When renewables like wind and solar came along they posed an additional challenge for grid operators with their extremely variable power outputs and intermittency.**

**It’s worth pointing out here that everything connected to the grid has some level of intermittency. Wind and solar are pretty obvious because we can see when the skies get cloudy and we know it gets dark at night and we can tell when it’s not windy, but fossil fuel plants and nuclear power stations also have occasionally variable outputs, failure rates, and operational limitations.**

**Even something as apparently innocuous as hot ambient air on a summer’s day at a gas fired power plant can lower that plants electricity output quite significantly, just when the residents nearby are switching on their air conditioners and increasing their electricity demand.**

**And that’s where that frequency that I mentioned earlier comes into play, because frequency isn’t only a function of the speed that the turbines are turning, It’s also a function of energy demand on the grid at any given time. Large imbalances between electricity produced and electricity consumed can result in power surges or brown outs or in worst case scenario even a complete system collapse.**

**If the frequency on the grid starts deviating from 50 or 60 Hertz, the transmission system operator or TSO needs to influence the amount of energy supplied to, or taken from, the grid. And that brings something called frequency containment reserve or FCR into play.**

**FCR has to respond very quickly and accurately to frequency variations. Renewables can make this job even more difficult, but energy storage solutions like grid scale lithium ion batteries are matching that challenge with their ability to instantly and precisely respond to frequency fluctuations in a way that gas and coal fired power plants simply can’t manage with their generator ramp up delay times.**

**Earlier this year the European Association for Storage of Energy or EASE, released this report called the European Market Monitor for Energy Storage.**

**The report points out that Europe’s Frequency Containment Reserve market is now interconnected between Germany, France, Austria, Belgium, the Netherlands and Switzerland, with Denmark due to join soon. That interconnection has further increased the efficiency with which battery storage can balance the supply and demand across the majority of the continent.**

**But Corentin Baschet, head of market analysis at the Energy Consultancy firm Clean Horizon, told Energy Storage News recently that frequency control is “not the only thing that batteries can do,”**

**and that the business case for batteries in the UK has already shifted**

 **“from frequency regulation to more wholesale revenues from the balancing mechanism to day-ahead and intraday trading”.**

**“It’s just a matter of time” he says “before we start doing this in Europe”**

**So what’s that all about?**

**Well, according to this definition by the Irish operator SEMO,**

**“The Day-Ahead Market, or DAM, is a single pan-European energy trading platform in the ex-ante (or estimated) time frame for scheduling bids and offers and interconnector flows across participating regions of Europe. The DAM involves the implicit allocation of cross-border capacity through a single centralised price coupling algorithm called EUPHEMIA. The algorithm, taking into account the cross-border capacity advised by the transmission system operators, determines prices and positions for all participants in all coupled markets.**

**The Intraday Market, or IDM, allows participants to adjust their physical positions closer to real time, based on more up to date information for trades to occur.**

**And of course, it won’t just be lithium ion batteries providing these services either. This is where longer duration systems like liquid air and flow batteries, amongst others, will come into their own as the race to capitalise on this lucrative and rapidly expanding energy storage market really starts to hot up.**

**The European Energy Storage Market report that we looked at earlier points to the fact that policymakers in Europe are themselves now seeing the value that energy storage can bring to a rapidly decarbonising network, stating that “the future of energy storage in 2020 in Europe remains positive as the energy transition progresses”.**

**And this initiative from the EU, called the Clean Energy Package or CEP is yet another positive boost for energy storage, according to EASE senior policy advisor, Brittney Elzarei, with the technology expected to play a key role in meeting the CEPs ambitious “32% by 2030” renewables target,**

**Elzarei says “the package sets a high level of ambition that can only be achieved with the widespread deployment of flexibility solutions such as storage."**

**And it’s not just grid scale or so-called Front of Meter energy storage that’s set for a revolution either. The report says the Clean Energy Package, which is due for ratification by all EU member states in 2021, will include ways to incentivise behind-the-meter solutions as well. Smart meters in our homes combined with Solar panels and battery storage like the Tesla Powerwall, as well as battery to grid technology in Electric Vehicles and domestic appliances will all play their part in smoothing demand on the distributed smarts grid currently being built out across the continent, making large centralised fossil fuel power plants increasingly economically unviable and obsolete.**

**Valeska Gottke, of the German Energy Storage Association goes a step further in this February 2020 article, arguing strongly that energy storage needs to**[**become the vital “fourth pillar of the energy transition”**](https://www.energy-storage.news/blogs/energy-storage-and-the-eu-the-push-for-carbon-neutrality-is-underway) **alongside Generation, Transmission and Distribution**

**And systems like this one from Power Ledger are bringing blockchain into the tracking and management of millions of daily micro and macro transactions. As the company’s co-founder Dr Jemma Green puts it**

**“The opportunity Power Ledger has identified is to link the macro of green energy production to the micro through a trading platform that businesses and everyday consumers can use to trade energy peer-to-peer and to the market to stabilise the system. There are many possible configurations” she says**

**“A household with solar panels can sell excess power to a neighbour. A household with a battery can sell services to the grid to keep it stable. Another household using the platform can choose to source its power from an external renewable source. Businesses can do the same, either selling their excess renewable power or using the platform to tap into a green source.**

**All of this is made secure and convenient through the Power Ledger platform’s use of blockchain technology to record and track energy transactions. This allows for greater transparency, increased automation and reduced possibility of human error.**

**For energy retailers, the blockchain-enabled platform improves efficiencies by enabling peer-to-peer transactions, virtual power plants from small batteries combining, renewable energy certificate trading, and energy provenance tracking.”**

**The energy generation, and storage, revolution in Europe is well under way, but it’s not alone.**

**According to a report from market analysts Navigant Research,**

**7 other countries are following the EU and the UK and together they’ll account for 80% of global utility scale energy storage.**

**China tops the list of course, but Australia, India, Japan, South Korea, Brazil and the United States are all fully engaged in the transformation of their grids, and the integration of energy storage solutions.**

**Just this month, PV Tech reported on a landmark ruling by the United States Court of appeal in the District of Columbia. The court ruled against petitioning from the US National Association of Regulatory Utility Commissioners which sought to prevent legislation called the Federal Energy Regulatory Commission Order 841 from passing.**

**The order means that distributed energy storage units can now compete directly with fossil fuel resources to provide grid services in wholesale markets.**

**Chairman of the FERC, Neil Chatterjee, called it the**

**“single most important act we could take to ensure a smooth transition to a new clean energy future.”**

**Californian supplier Power Corp sums up the North American challenge and opportunity very well, telling us that an investment of 7.5 trillion US dollars in renewable energy is expected over the next 20-25 years and that energy storage is set to become a 20 billion dollar per year market by 2040, a ten-fold increase from today.**

**They point out that the United States and Canada rank 1st and 2nd in the world, in the amount of electricity used per person and that over the next 20-25 years, this consumption is expected to increase by 2% per year representing 10 trillion dollars in new electricity investment. Seventy-five percent of that growth is expected to come from renewable sources, thanks to the rapidly falling cost of renewable energy and energy storage.**

**North America’s electricity grid is approximately 120 years old and Power Corp suggests that about a trillion dollars of investment is needed over the next 10 years just to maintain its current performance.**

**Energy storage is accelerating the development of US distributed smart grids similar to the European model, resulting in the delivery of electricity with more reliability and efficiency, the reduction in the frequency and duration of power outages, improvements in security, a lowering of peak loads and the minimisation of repairs on the grid infrastructure.**

**Naysayers will probably disagree with much of what I’ve presented today, but while those people debate and deny what’s happening right in front of them, the simple fact is that these networks are being built out in many key areas of the world, making the economics and practicality of renewable energy sources ever more competitive against fossil fuels as each day goes by.**

**As usual, if you have a view on this developing market, good or bad, for or against, then jump down to the comments section below and share your thoughts there.**

**That’s it for this week though.**

**A big thank you to our supporters over at Patreon who keep the channel going and also keep it fully independent, and a special shout out to the folks who’ve joined in the last couple of weeks with pledges of ten dollars or more a month.**

**They are**

**Scott Vye**

**Gregg Montesi**

**Charlie George**

**Steve Reid**

**Justin Lawler**

**Randy Ross**

**Wayne G**

**And**

**Bobby and Emelio Garcia**

**And of course, a big thank you to everyone else who’s joined since last time too.**

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**and you can support the channel absolutely for free by subscribing and hitting that like button so we get noticed by YouTube’s search algorithm and get the message to more people each week.**

**Dead easy to do that of course. Just click down there somewhere or on that icon there.**

**And don’t forget to hit the bell icon as well so you get notified of new content.**

**As always thanks very much for watching, have a great week and remember to Just Have a Think**

**See you next week.**