**Can the electric grid ruin your EV battery?**

**Back in twenty eleven, when the very first brave pioneers took delivery of the newly launched Nissan Leaf and attempted to explain to their friends and neighbours why there was nowhere on the vehicle where they could insert the nozzle of a petrol or diesel pump, the average cost of the BATTERIES that provided the ALTERNATIVE automotive propulsion for those vehicles was just over a thousand dollars per kilowatt hour. That meant that roughly two thirds of the cost of the entire vehicle was taken up by the battery pack that was bolted to its chassis.**

**Fast forward to today, and despite a twenty-twenty-two price blip caused by supply chain issues with lithium, nickel and cobalt, the average cost of EV batteries in twenty-twenty-three is a hundred and thirty-eight dollars per kilowatt hour. That means that, even though modern battery packs are often more than twice the size of the original Nissan, prices for new electric vehicles are getting very close to parity with their internal combustion engine counterparts.**

**And the rapid adoption of lithium-ion-phosphate batteries that don’t contain any nickel or cobalt, and other promising chemistries like sodium-ion, sodium-sulphur and lithium air, many of which we’ve featured on this channel, will most likely keep that cost curve moving in a generally downward direction for some time yet.**

**So, according to many market analysts, we really are now at the tipping point of mass adoption for this historically disruptive technology, just as was predicted more than ten years ago by visionaries like Tony Seba in the US and our very own Robert Lewellyn here in the UK.**

**And that opens up a whole new set of challenges and opportunities, not least of which is how to make best use of millions of powerful battery packs that, statistically speaking, will spend ninety percent of their existence sitting doing nothing at all at the side of the road or in driveways and garages.**

**So, should these otherwise under-utilised sources of energy be hooked up to our national electricity networks to provide some much-needed extra demand response as consumption continues to rise in the coming years, or is that just a cunning plan to get electric vehicle owners to subsidise grid stability costs at the expense of the operational lifetime of their own car’s battery pack?**

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

**According to the United States Environmental Protection Agency, or EPA, the average American household consumes twenty-nine kilowatt hours of electricity per day, which by the way is almost three times the average consumption here the UK, but anyway, the point is a typical modern electric vehicle battery pack now has a capacity of more than forty kilowatt hours, which means there are enough electrons in there to run even an American household for almost a day and a half. In fact, the recently launched Ford F150 Lightning, which has a base model with a battery pack size of ninety-eight kilowatt hours, boasts the ability to fully run your home for up to three days if necessary, which is a feature that makes it an attractive proposition to anyone who’s had endure an extended power cut like the one that closed down much of Texas during the winter of twenty-twenty-one.**

**And with future electricity grids incorporating an ever-greater proportion of intermittent renewables like wind and solar, it’s not difficult to see why grid operators are viewing the advent of electric vehicles as an opportunity to smooth out the peaks and troughs of supply and demand by using available electrons from EV batteries when demand is high, and then sending electrons back into those batteries during off-peak hours or when supply from wind and solar is higher than required.**

**Quite how effective that strategy might be has been the topic of hot debate for some time, but in January twenty-twenty-three, a new research paper was published that analysed the issue in almost forensic detail.**

**The study looked at the world’s largest EV regions ; China, India, the USA and Europe, with a fifth category accounting for everywhere else. Combining their own research with data from previously published analysis by major organisations including the International Energy Agency, The International Renewable Energy Agency, The US Department of Energy and The US National Renewable Energy Laboratory, the research team produced a bang up to date assessment not just of vehicle to grid opportunities but also the potential for what’s known as ‘end of life’ repurposing of vehicle batteries into stationary utility scale energy storage. That’s an important consideration because even if a battery’s capacity drops to maybe eighty percent or so after a couple of hundred thousand miles of driving and is therefore no longer quite good enough to propel a car with the same vigour as a new battery, it’s still perfectly viable for many more years as an energy storage medium in a situation where all it has to do is provide electrons for grid stability.** **Given their economic value, their physical size and weight, and regulations around end-of life use, it’s fairly reasonable to assume that all these batteries will be collected rather than being crushed along with the rest of the vehicle. After all, the lead-acid batteries used in cars today have an almost one hundred percent collection rate, and EV batteries are a far more valuable commodity. So, they’ll be collected and given a health check. Any battery below seventy percent of its original capacity will be recycled, and all the others will be allocated for second life use. The authors of this paper reckon about three quarters of all retired batteries could be repurposed in this way by twenty fifty.**

**Overall, the research team found that, based on the range of market growth forecasts, EV batteries will have what they describe as ‘a global technical capacity’, which they define as the total cumulative available EV battery capacity in use in vehicles AND in second-life use at any given time, of somewhere between thirty-two and sixty-two terawatt-hours by the time we reach mid-century, which for context is almost twice the total annual electricity consumption of Denmark.**

**And even if only FIFTY percent of all retired EV batteries were repurposed into electricity grid storage facilities, then the paper’s authors found that the participation rate in vehicle to grid electron sharing could be less than ten percent while still providing all necessary short-term grid storage as early as the end of this decade.**

**But what about the thorny question I posed right at the start of the video? Does the constant back and forth of electrons between your EV and the grid mean your car’s battery pack is going to get degraded much more quickly, causing you to have to either replace the pack or change your vehicle more often than you would otherwise have to?**

**Well, that was indeed specifically one of the models that the research team included in the paper. The resultant flow chart is a classic example of what happens when very clever people quite rightly include every possible variable and metric into their calculations to ensure they arrive at the most accurate outcome. That’s great from a technical point of view but not so good from the point of view of presenting to normal people like you and me. It’d probably take an entire separate video to properly analyse ALL the calculations involved in this thing, but as a brief overview, it takes into account crucial factors like state of charge, depth of discharge, speed of charging, average country temperature and cycle life degradation among others. If you’re a fan of things like square roots and calculus then I’ve linked the full paper in the description section below, so you know…fill your boots!**

**The long and short of it is that, according to the findings of this particular research paper, just five percent of the theoretical available battery capacity is likely to be lost as a result of battery degradation by 2050. Now, it’s worth noting here that the way we interact with electric vehicles may well change in the future anyway. The current obsession with longer range and faster charging times is arguably a delusional mindset based on an internal combustion engine refuelling model that’s been engrained in our collective psyche for nearly a hundred and fifty years. You’re actually much more likely to degrade your EV battery quickly if you constantly use modern ultra-fast chargers at motorway charging stations than you would be by slowly charging overnight at home or via an on-street charger, even IF your car IS sharing electrons with the grid all night long. As EVs become a mainstream commodity and charging points become ubiquitous in the coming years, consumers will most likely get used to this dynamic and become far more relaxed about charging their cars, just like we all had to learn how to charge our smart phones in a rational way when they exploded onto the scene more than a decade ago.**

**OK then, so what about the electricity grids themselves. We’ve all no doubt heard the horror stories about the constant blackouts that we’re all going to be suffering as a result of millions of new electric vehicles. So, will we really be risking the wholesale meltdown of our grids and societal chaos that some of our tabloid news outlets are suggesting?**

**Well, while that’s not specifically addressed within the scope of this research paper, it IS a calculation that was fairly carefully considered by graduate mechanical engineer Jason Fenske over at his Engineering Explained channel back in twenty-twenty-one. I’ve linked that video in the description below but as a very brief summary, Jason pointed out that the capacity of America’s various electricity grids quietly grew by an average of four percent per year during the forty years between nineteen sixty and the turn of this century, largely to accommodate the enormous number of new air conditioning units, and all sorts of other electrical devices that American consumers now take for granted as part of their everyday lives. Jason showed that if that fairly modest average annual capacity increase continued from today onwards then it would only take six and a half years for there to be enough extra capacity on the US grid to enable every single one of America’s two hundred and thirty million licenced drivers to switch over to an electric vehicle.**

**There’s no doubt though, that properly harnessing the potential of vehicle to grid energy sharing will have critical implications for the energy transition. And that means our policymakers will need to fully understand the risks and opportunities so that they don’t make epically stupid decisions that mess the whole thing up. There will need to be attractive incentives in place, like decent micro-payments for services to the grid. And we’ll probably need some regulations in place to make sure the relevant hardware and software solutions like smart charge controllers can be seamlessly integrated so that consumers get as much benefit as possible from cheap, off peak supply, AND to ensure that batteries are genuinely recovered at the end of their automotive lifetimes and easily integrated into the grid.**

**There’s been a lot to cope with over the last few years what with pandemics, fuel crises and illegal invasions, so it’s not hard to see how the energy transition might have passed many of us by. But make no mistake dear friends, we are right in the thick of it. Right now. And the technological revolution that’s about to touch all our lives will be very similar to the one we experienced shortly after Steve Jobs held up an iPhone for the very first time back in two thousand and seven.**

**No doubt you’ve got your views on this one, and I’m very interested to hear what those views are, so I’ll be down in the comments section below here for a while now, to see what you think.**

**That’s it for this week though. A huge thank you, as always to the channel’s Patreon supporters who enable me to keep ads and sponsorship messages out of these videos and provide me with feedback to keep the content as accurate as possible. And an extra special thank you to the supporters whose names are scrolling up the screen beside me here, all of whom celebrate and anniversary of Patreon membership in March. You can join them and get exclusive early access to all my videos, as well as regular exclusive extra content from me, AND the chance to influence the video topics we chose via monthly content polls by visiting patreon dot com forward slash just have a think.**

**And of course, if you found this video useful and informative, then you can help the channel absolutely for free by clicking the ‘subscribe all’ option in YouTube’s drop down menu so that you get notified whenever a new video comes out.**

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

**See you next week.**