**Ever since Nikola Tesla invented his Tesla Coil way back in 1891, boffins in laboratories have been tinkering with the basic principles of his creation to try to make wireless charging a commercial reality.**

**And of course, nowadays it is. At least to a limited extent anyway. If you set your phone down on one of those charging pad thingy’s or put your electric toothbrush onto it’s stand to charge overnight, then you are already using wireless charging technology.**

**So, as the world moves ever more rapidly away from internal combustion engine vehicles and towards electric vehicle alternatives, I suppose it was only a matter of time before researchers started looking for ways to scale up wireless charging as part of that expanding industry as well.**

**As with all new technological sectors, there’ve been various different approaches to solving the technical and logistical challenges involved. Those challenges have proven to be surprisingly difficult to overcome in any kind of economically viable way, but now it looks like we’re finally on the cusp of some major advances.**

**So, will wireless charging be coming to a street near you soon, and can it be the catalyst to really democratise electric vehicle ownership?**

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

**If you could somehow travel back to medieval times and demonstrate how a light can be illuminated simply by flicking a switch in a nearby wall, the good folks of that era would most likely accuse you of being a witch and set fire to you without delay.**

**Thankfully, electricity is now something that most human beings take completely for granted. But even by our modern standards, this wireless charging thing is next level stuff isn’t it?**

**It works on the principle of electromagnetic induction, which is one of those concepts that I vaguely remember drawing diagrams of in an exercise book back in my school days.**

**It was actually Michael Faraday that did most of the leg work on electromagnetic induction, back in 1831. Essentially if an alternating current is put through a coil of wire, it generates a magnetic field around it. If another coil of wire is brought into close proximity, then the magnetic field induces a secondary current in that coil.**

**That secondary current can then be made to do something useful like charging a battery.**

**It works really well at very short range for things like your phone and toothbrush, but there’s an inconvenient physical constraint that the science bods call the inverse square law which states that because the magnetic field radiates in all directions then its energy diminishes very rapidly over distance. So, induction chargers have to ensure the primary and secondary coils are placed as close together as possible to get the most efficiency out of the system. That efficiency is also determined by the alignment and cross-sectional area of the two coils. So, the best results are achieved when the two coils are of identical size and are perfectly aligned parallel to each other with a separation of only a few millimetres. That’s known as the Coupling Factor. A perfect set up would have a coupling factor of 1. Typical real world induction chargers achieve factors of between zero point 3 and zero point six.**

**So, scaling that concept up to work properly on electric vehicles that are obviously way more than a few millimetres off the ground and are often very imperfectly parked, has been a significant technical mountain to climb.**

**At the start of this century research teams, including the Massachusetts Institute of Technology, or MIT, realised that if you could somehow prevent the magnetic flux from radiating out in all directions and instead focus it directly just onto the secondary coil, then you might be able to negate the effects of that pesky inverse square law and have a much more efficient transfer of energy.**

**What they came up with is a pretty complicated piece of physics known as magnetic resonance. Much of that physics is beyond the scope of my brain and this video, but in basic terms it involves tweaking the resistance, inductance and distributed capacitance of the coils to make them both operate at precisely the same resonant frequency. That causes the energy to move from one coil to the other in something more like a tunnel rather than an omnidirectional flux. The consequence of that is far stronger coupling between the coils, with energy transfer increasing to several tens of centimetres. And even better news for EV wireless charging developers is that the energy transfer turns out to be much less reliant on the coils being perfectly aligned, so overcoming sloppy parking or even charging moving vehicles began to look like a distinct possibility.**

**As usual then, in these market-driven technological sectors, the race is now on to develop the best, most commercial and therefore most successful wireless charging solutions for the hundreds of millions of EV drivers that will exist by the end of this decade.**

**Over in the States, the folks at the U.S. Department of Energy’s Oak Ridge National Laboratory, or ORNL have been working on a version of the technology that they refer to as a ‘unique polyphase electromagnetic coil’. They recently licensed the tech to a Brooklyn-based company called HEVO. They claim a surface power density of one point five megawatts per square metre. According to ORNL, that’s about eight to ten times higher than currently available technology. That enables very fast hands-free charging and could even see vehicles being charged as they drive, on specially modified roads.**

**HEVO founder and CEO, Jeremy McCool said**

**“From only one device mounted on the vehicle, a driver will now have the advantage of wirelessly charging at all levels up to 300-kilowatts, powering their home through a vehicle-to-grid interface, and even charging while driving at highway speeds with grid-to-battery efficiency of ninety to ninety six point five percent All of this functionality is built into a vehicle-side package the size of a medium pizza box and the ready-made capability to charge electric vehicles without a human behind the steering wheel.”**

**They’ve got competition though, most notably from two other US players, WiTricity and WAVE.**

**You may have already heard about WiTricity’s technology from Matt Ferrell’s excellent site visit video, which you can jump over to by clicking up there somewhere.**

**WiTricity have been perfecting the magnetic resonance technique for some years, and in an extremely refreshing break from the normal proprietary protectionism of most modern tech companies, they have actually come up with a completely interoperable standard and supporting infrastructure that will allow any auto maker in the world to build EVs with wireless charging capability, whether they’re producing sports cars or SUVs. In fact, their technology has actually been adopted into a proper industry standard with the inspirationally catchy title of SAE J2954.**

**The WiTricity chargers can transmit through all sorts of materials and obstacles, at efficiencies of between ninety and ninety-three percent from gird to battery. That means they can be sunk into asphalt roads and driveways and can even cope with adverse weather conditions like snow and ice cover.**

**WiTricity see a huge opportunity in the fledgling autonomous vehicle market, including Robotaxis. Human beings won’t want to get involved in the running of these new vehicles. We’ll expect to simply summon one with an app, get in, travel to our destination and get out again. So, WiTricity have coined the term ‘power snacking’ for autonomous vehicles of the future. Taxis will queue up at ranks that have induction chargers below the surface, and each time they return to the back of the line they’ll pick up a bit of extra charge. And the same thing could be installed into dedicated taxi and bus lanes in urban settings so that vehicles are sort of grazing on energy all day long while they’re on the move. That means they’ll be able to keep going throughout the day without any costly stoppages at stationary recharging points.**

**WAVE is an acronym that stands for Wireless Advanced Vehicle Electrification. They’re owned by a NASDAQ listed company called Ideanomics and they’re focussed on extreme fast charging systems for the medium and heavy-duty end of the market with a proposal for charging speeds of up to one megawatt from sub-road wireless chargers using the same magnetic resonance techniques we looked at earlier.**

**WAVE are partnering with Tesla to get their receiver boxes factory fitted to the new range of Tesla semi-trucks whenever they finally hit production. If the hype around these new electric trucks is true, then they look like they’ll dominate their market. And that probably means Elon Musk will launch himself with characteristic gusto into the challenge of installing the charging highways across the United States that will be needed to support the wireless charging technology rollout. Apparently, he’s going to be the world’s first trillionaire soon isn’t he, so I guess he’s got a few bucks that he can throw at the problem.**

**BMW launched a wireless charging pad for their 530e model back in 2019, claiming the prize of becoming the first auto maker to have this technology actually available to buy. But the 530e is not a fully electric vehicle, it’s a hybrid, so with the best will in the world, the charging pad was really nothing more than an expensive trinket that BMW owners could show their friends when they came round for dinner.**

**Of course, that utopian dream relies on all new electric cars being fitted with the correct receiver boxes, and let’s face it, none have been. Until now.**

**This little beauty is called the Genesis GV60, and it’s the first all-electric vehicle with genuine wireless charging capability.**

**It’s not a bad looking thing either is it?**

**Genesis is a South Korean car brand, but they’ve chosen WiTricity’s technology for their wireless charging system. That’s pretty much exactly the opposite way that technology advances have been flowing in recent years and it represents a big win for a pioneering US company.**

**According to Genesis, the car will carry a 77 kilowatt-hour battery that can be fully charged with two hundred and seventy miles of range in about six hours via the wireless charger. That compares very favourably with ten hours using a domestic wall mounted charger.**

**The Genesis GV60 goes on sale in South Korea at the end of 2021 and it’ll be available in the State in mid-2022.**

**One of the most important advantages of these wireless home charging system is their ability to help stabilise grid frequencies as electricity demands continues to rise in the future. A battery is most useful to the grid when it’s full of charge, but car owners with wall mounted chargers are unlikely to plug their vehicle in when their batteries are fill – why would you? That means the grid can’t get at the very useful energy source sitting on the driveway or in the garage. With induction charging you won’t be plugging anything in, so as long as you park your car over the charging pad, the grid will be able to access your car’s battery automatically without you lifting a finger.**

**There are still naysayers who claim that electric vehicles aren’t practical and that they get the electricity from fossil fuel power plants, and anyway they’d fry our grid systems if everyone had one and on and on. There will of course always be laggards in any normal distribution curve. If those people had lived a hundred and fifty years ago they would probably have been dismissing the automobile as a useless impractical fad that would never replace the horse and cart. It just demonstrates a lack of open mindedness and vision for how new technologies can and do disrupt existing systems. The reality is that electric vehicles are rapidly gaining in popularity among the buying public, and they are here to stay. So, the quicker these complimentary technologies can be rolled out, the quicker we will transition to a more sustainable energy future.**

**No doubt you’ve got your view too though, so the place to share that is down in the comments section below.**

**That’s it for this week.**

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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.**