PODCAST

Mobility Revolution

ABB Decoded

Mobility revolutionIn the first episode of our new podcast series, ABB Decoded, ABB's Head of Global E-mobility Infrastructure Solutions, Frank Muehlon, explains how electrification is transforming every mode of transport: from cars, to buses, to water taxis and even planes. What challenges, opportunities and changes await us, as electric vehicles (EVs) are "becoming a mass phenomenon"?About Frank Mühlon-Frank Mühlon was appointed Managing Director of ABB's E-Mobility Infrastructure Solutions business in 2017.The global business provides the whole range of cloud connected charging and infrastructure solutions from AC charging, DC fast charging and Ultra-fast charging to eBus / heavy vehicle charging with high power.Prior to this role, Frank was Global Head of the Low Voltage modular devices unit and Managing Director of ABB Stotz-Kontakt GmbH in Heidelberg. Before joining ABB in 2014, Frank had several global general management positions within the Automotive Division of Bosch and worked in Germany, China and the US.Frank has a master's degree in mechanical engineering and business from the University of Darmstadt, Germany.

Anthony: Hello! And welcome to the very first episode of an exciting new ABB podcast: ABB Decoded. I'm your host, Anthony Rowlinson, and in our new series we will be talking to leading thinkers and innovators about the new technologies that are reshaping our world at a rapid pace.

Over the coming weeks, we'll be exploring developments in sustainability, e-mobility, and de-carbonization, for example. Then we will be touching on topics such as diversity & inclusion, the fourth industrial revolution, working with robots and smart technology for our homes and cities.

Technology advances are happening at such a rapid pace that it's sometimes hard to keep up with the changes we see all around us every day. And that's where ABB Decoded will step in to help keep you up to speed.

For our first episode – Mobility Revolution – we've chosen to focus on an area of rapid change that touches each of our everyday lives: e-mobility and the electrification of transport. Of course, that means electric cars and buses, which are becoming an increasingly familiar sight on our roads. But it also means the infrastructure changes that are necessary to allow EV usage to increase, and the government policies that are being re-framed to promote e-mobility.

It's a fascinating world, full of opportunity and complexity, and here with us today to navigate us through an electrically driven transport future, is Frank Muehlon, ABB's head of Global e-mobility Infrastructure Solutions. Hello, Frank.

Frank: Yeah, hello, Anthony.

Anthony: Frank, it's great that you can join us, but before we begin, here's a brief recap on electric vehicles. It's easily forgotten that some of the very first vehicles on our roads were powered by electricity – their history dates back to roughly 1900, when around a third of cars on the road were EVs.

They were slow and powered by heavy lead-acid batteries, but the potential of the technology was evident right from the start. Some of the same benefits that EV drivers enjoy today, such as ease of driving and zero exhaust emissions, were just as relevant then.

But their early growth was nipped in the bud by the discovery of large oilfields around the world. Very soon, the production of cheap gasoline was in full flow and the range advantages of petrol-powered cars led to the decline of EVs. This, in turn, drove the development of motorway networks, which locked in the advantages of the gas-guzzlers.

Now though, more than 100 years later, battery and charging advances are allowing EVs to become more relevant than ever, so it's the perfect moment to be discussing the mobility revolution. Frank, perhaps you could bring us up to speed on the pace of change in the mobility sector.

Frank: Yeah, of course I'd love to. So, and indeed, where we are at right now is really rare in the mobility sector. We see that the sector is on the mind and on the top of everybody, and we're really at a disruption point. So the automotive industry, the automotive world is becoming really a part of the electrical world. So, the two worlds merged together and, in the past, they were really distinct industries. And that's no longer the case. In the next 10 years, we see them really coming even closer together. And if you look at the at the pace and at the advance of the industry, what it took so far, it's really interesting to just look back at the last 10 years. So, 10 years back, ABB installed the first commercial DC Fast Chargers in Europe. It was in Netherlands. And back then, we could charge a car potentially with maximum 50-kilowatt hours. But the cars were not ready yet. But the chargers then 50 kilowatts, 10 years ago as a maximum. And that could give a range of about 150 kilometers in about 30 minutes. In a very ideal case today, 10 years later, we're kind of the market leader in the Western world with DC Fast Chargers, sold about 14,000 DC fast chargers globally in more than 80 countries. And many of those actually have power ranges of up to 350 kilowatts. So, they are our Terra high power fast chargers and those can actually charge a car up in less than 15 minutes, about 80 percent capacity of the battery.

The same is true not only for cars, but also for public transportation and in public transportation. And today is you see that in a lot of cities, and you see that buses are charged and in five to six minutes, again, up for the next 150 km. So, you can really go in definite ranges, if you like. And this is just two examples, but real game changers and of course, that the progress doesn't stop at all. The world's top 20 car makers almost spend about $100 billion on research and development just in the last year in order to accelerate their transition to produce and develop electric and autonomous vehicles. And on top of that, countries such as the UK announced the $47 million spend of government finance to design, test and produce electric transportation solutions in the country. So, we actually see it from the industry, and we see it from governments. And, of course, we will fully push into that. So we, earlier this year, inaugurated our new R&D e-mobility center in Delft in the Netherlands, on the campus of Delft University. And there we have the capability to test vehicles and to test chargers combined. The facility is even built in a way that we can drive buses or trucks inside the facility and even charge inside the facility. And also, we just announced that we opened a new factory in Italy to cope with the high demand we have and EV charges.

Anthony: It feels, Frank, like suddenly there's almost an explosion of interesting mobility and technology advances at the same time. So perhaps, for some of the listeners who may not be quite so expert in this field as yourself, you could tell us about the different types of electric vehicles that people might be encountering now?

Frank: Yeah, so if we look at electric vehicles, if you start from the most simple form of an EV, that would be kind of a mild hybrid on a 48-volt basis. So, that's the least amount of electrification you can do. Basically, what you have is a bit an oversized starter motor, also working as a generator alternator. And so, battery is also a bit oversized. And what you what you can do is typical start stop operation or you can go into kind of sailing mode.

I mean, the engine can switch off when the propulsion is not needed. And at high energy output, actually, that alternator can even help to boost and the opposite, it can really, really recuperate energy back into the battery. Then you have the full hybrid. A full hybrid basically is a combination of a combustion engine and an electrical engine. And the combustion engine kind of at the end powers the battery as well. And then you can drive inside a city. And from that battery powered by before by the combustion engine. Of course, that's not ideal because you still have the combustion engine to burn fossil fuels to power everything. So, the next step is a plug-in hybrid, where you load the battery from

actually from the charger, from plugging it in. And then you have a certain range can be like 20 to 50 kilometers, ideally up to 100 kilometers. But that's a pretty big plug in hybrids. You can drive electrically pure electric. So average, I would more say, is like 20 to 50 kilometers max. But then you still have to propulsion systems and electrical system and a combustion engine and kind of you have to think, is it now ideal or is a bit like a duck? It can swim and fly, but nothing really proper. So the next step is to have a full battery electric vehicle. So, you kick out the combustion engine completely and have a pure electrical motor to drive and run purely out of a battery. So that that's what we talk about right now. These days, that's the mainstream and that's what you talk about when you talk about an electric vehicle.

Anthony: We're seeing some really amazing vehicles coming out now, like the Porsche Taycan, for example, which is capable of taking a very high charge from an ABB charger.

Frank: Yeah, that's, of course, the premium vehicle, which can really take the highest amount of charge. But let's not underestimate the Teslas as well. Right. I mean, that they already play in that league as well. And there's another type of electric vehicle, which is the fuel cell vehicle. There, instead of taking the energy for the electrical motor from a battery, you generate it on site with the fuel cell. Now, there's a lot of debate on what is the better technology. I would simply say it's like usually depends right? It depends on the use case.

So, if the use case is a car or inner-city transportation or whatever, I would always go fully electric because it's the technology available today. Whilst in fuel cell, it's the much more expensive technology at least today, and will also be like that for the next couple of years and also because of the missing infrastructure. If you have a particular use case, then probably fine, else it's more restricted to a longer-range trucks or ships or aviation and so on.

Anthony: Obviously, all these vehicles need charging in their own different way, so perhaps you could, again, just in quite simple terms, explain the different types of charging for consumers and businesses.

Frank: Let's start from the most simple form is your plug. That's what we call level one charging. It's about 3.6 kilowatts at the max and that means about eight kilometers or five miles. You can charge within one hour. So then it's basically you better do not use your vehicle too often or you only use it for very, very short distances. Then the most used type of charging is the level two charging or we also call it AC charging. And this, of course, is three to seven times faster than the level one.

It goes to charge rates of about 11 kilowatts, up to 22 kilowatts. But now it's not so much the charger which determines the charging speed here, because the conversion from AC to DC happens inside the car in the so-called onboard converter. And there you can get like 40 kilometers or 25 miles in about an hour. Right.

So that means if you park your car for a longer period overnight, et cetera, that's the right means of charging. So overnight charging at home or charging in at workplace.

Anthony: So that's quite a consumer friendly type of charging.

Frank: Yeah, absolutely. So ideally, if you have an EV and you have the opportunity to plug in at home or you have the opportunity to plug in at your workplace, you don't need to go anywhere else, right? So you just park and plug in and then that's it. So, you really completely get rid of this this go into a petrol station type of thing.

Anthony: Do you think this is part of the mindset change that people are experiencing? Well, maybe people have to actually understand that you don't need to go to a petrol station and you can actually do this – if you're lucky enough – in your garage or your drive or a charging point on the highway. Do you think that's part of what people need to start to understand more?

Frank: Yeah, absolutely. I mean, people who drive EV, they understand that and they start enjoying it. People who do not drive EV, they're always concerned about the range. So, oh my gosh, I can only go that far. And then I have to search for a charger and then this charger is slow or is not working. And it's a nightmare. Right. So, but if you drive already and then you can plug in and it's actually it's luxury. It's just the opposite.

But now still, of course, you also want to drive longer distances with your EV or you don't have the opportunity to plug in at home because you live in a larger apartment building, you don't have your own grid connection and so on. What you then need is a faster charge. And it's basically that kind of petrol station experience where you go to a place to charge.

And so that's what you do in DC fast charging. And in DC fast charging, you have a range usually. I mean, you can start low also 11 kilowatts, but that's not the usual one. So, you go up to the 50 kilowatt I mentioned earlier or a high power charger of up to 350 kilowatts. And then what is determining the charging speed is no longer the onboard converter. But it's actually the battery you have in your car. How much charge can a battery accept over in a certain period of time without getting overheated? And then in an ideal case, you can get like 80 percent charge of your battery in like 12 minutes or like 200 miles in 12 minutes. I mean, that's the Porsche Taycan example.

So it's fascinating that the technology is ready to make EVs kind of very easy for people to use, but really the infra-structure is not quite there yet and playing catch up on that level.

Right. And there's also because you were mentioning the mindset change earlier. I mean, also with DC fast, that can combine it with a mindset change because you do not need to have kind of the petrol station experience. You go there for four, five minutes to fill up your tank and afterwards you look for a place to wash your hands to get rid of the smell of your hands, right? So but you plug in there and stay there like 15 to 20 minutes.

So, it's a small coffee break, for example. Or you can combine with a grocery shopping or whatever, right? So you really try to combine, and this is then also the places where these charges are located. And it's much easier to, of course, to bring electricity to these places than bringing large petrol tanks. Right. So, it means you will have a completely different density of charging opportunities going forward.

Anthony: Obviously, you've given us a great overview there of sort of where we've come from and pretty much where we are now. But let's look to the future, which is a particular entering point for ABB and the ABB FIA Formula E championship, because from season nine, which is 2022-23, we will actually be the official charging supplier to the championship. So, we're really going to be showcasing what is possible and perhaps you could give us a little glimpse of what's to come.

Frank: We're very happy, actually, to be the title sponsor of the Formula E Championship since 2018. And the race itself and how it how it's structured is very appealing to ABB from the type of competition and from bringing awareness to e-mobility and also that the races really take place inside larger cities. I mean, in normal non-covid time. So, you bring people close to e-mobility races and without bringing the that the smell and the noise you would usually bring with it with the car race. So, and that in itself brings people closer to technology and to a carbon neutral technology. And that's exactly what we want to do. Now, Season nine, we will also be the official charging partner for the ABB Formula-E race itself. I always try to put the pritch from the race to real life because that's where the learning should be. And I think in charging technology, we can learn from the race to make everything more robust, et cetera. But for the battery, I think for the battery manufacturers and then the car OEMs playing in there, it's even more important because the weight of the battery is decisive, the density of the battery and how to package it is decisive. And the C-rate how you can charge is if you have now a race condition, you probably want to do that a bit faster now and but then if you do it faster, there is, of course, thresholds and limits where you start to overheat, where you start to destroy the cells and so on. So, to take a learning there I think is important. And yeah, also for real life, it's the battery cost.

Anthony: It's fascinating to hear how the charging the battery just so completely interlinked. One you can't have one without the other, can you? They are very interdependent.

Frank: Absolutely. And as of course there's a logic, right. It's not a hardware piece battery and the hardware piece charger, there is a battery management system becoming the master in the charging process and telling the charger and how much energy now it can take at which moment in time so that the both are very, very interlinked.

Anthony: So, it's more than just simply plugging in and saying, here's some power. There's a lot of software going on behind that. We saw the first electric cars on the streets in the 1900s, but the rate of progress since then with not only the trucks that you've mentioned, fully electric fleets, autonomy, extensive charging networks, people have said for a long time, this is the future. It's the revolution that needs to happen. But actually, is it really the here and now? Are we actually living this new mobility reality, do you think?

Frank: Yeah, I think we're not there yet. I mean, in all honesty. We see a tremendous push. We see a tremendous increase. If you look a bit into the history here, which you started off, so we saw last year, 2019, 7.2 million EVs. So, battery electric EVs and plug-in hybrid. So, put that together on the road globally from 7.2 globally. However, in only last year out of these 7.2 million, 2.1 million came additionally. So, you can mathematically look at it and of course, see

that the growth is not linear. It's an exponential growth. We are still in the early phase but we will see an exponential growth rate in EVs.

Anthony: Is it easy to sort of predict that those curves you talk about like an exponential graph, can you actually sort of see where things are going? Is it predictable in that way?

Frank: We look at a lot of studies, Anthony, and there is quite a difference. And depending on which study you look at and I think what we tend to believe that about by 2030, probably like 25 percent of the cars coming to the market might be electric.

Anthony: Right. That's a very big and not very long time away and 10 years roughly.

So, Frank, we've talked more or less about consumers and EVs ¬– private mobility, if you like – so perhaps you could give us an insight into the commercial and public transport side, because obviously electric trucks, buses, and so on are very important for our daily lives.

Frank: Yeah so if you look at a bus and if you combine the bus with transportation inside a city as public transportation, you will soon realize that the quality of life inside a city is pretty much dependent on, let's say, the emissions public transportation causes, right. So, if you're in a city and the buses really smell and stink and are noisy, that's completely different to an electric bus, right. You hardly hear it and you don't smell anything, right. And of course, the emissions and the air quality is much cleaner inside the city. And then the adoption rate of public transportation will also go up. So that is really a clear driver for a lot of forward-thinking cities to get rid of diesel buses and replace them with electric propulsion.

And there's a lot of cities leading with good examples. The city of Santiago as the largest e-bus fleet outside China and of course, didn't talk about China. The city of Shenzhen has 100 percent electric buses, 100 percent electric taxis. So, we're really moving forward. And then it's the trucks as the next thing. I mean, if you take buses, diesel buses out the cities, you don't want to have your refuse trucks driving around and making a lot of noise and, a lot of, let's say, CO2 emissions or inner city transportation to the shops, to the shopping malls and then and whatever.

So, you really want to take out that part of noise and carbon emission too. And so last mile delivery here is the phrase. So, we really want to help that as well. And so, we see a lot of trucks, light commercial vehicles, but also heavy commercial vehicle trucks going to electrify. You probably heard about aviation even becoming electric or shipping and then there's water taxis and all sorts of stuff. But everything is becoming more and more electrical. And as soon as you see it on the benefits side, of course, there's always a certain threshold to jump over, but if you're over that and you see the benefits, it's kind of going exponential now.

It feels like there's a sort of almost tangible electric future just within touching distance, but maybe not quite today, but. But very soon.

So that's what we see. I mean, we see a really a low take rate right now. So, this is why we still say the future is electric. It's not there yet, but we're shaping it. And then I think we came a long way. I mean, 10 years, but only 10 years. Right. I mean, if you think how old the mobility industry is and now we're only talking about the last 10 years and which progress we've made the last 10 years. So, imagine the next 10 years and where we will be at.

So, we really coming out of that corner of only, let's say, where we technophile people driving electric and to really becoming a mass phenomenon.

Anthony: Frank, it's been absolutely fascinating to listen to you and to talk with you. Thank you so much for your time. And we look forward to seeing the next developments in this fascinating world.

Frank: Yeah. Thanks a lot, Anthony.