AirSpace Season 6, Episode 4: Electricity

Music up then under

Nick: Welcome to AirSpace from the Smithsonian's National Air and Space Museum. I'm Nick.

Matt: I'm Matt.

Emily: And I'm Emily.

Matt: So not that long ago, it was kind of rare to see an electric car driving down the street. In 2011 about 16,000 electric and plug in hybrids were registered in the United States and in 2021 that number surpassed 2 million.

Emily: Similarly, electric aircraft are up and coming. It's going to take a while, maybe even a lifetime, before commercial aviation goes completely electric. But hundreds of companies are working on developing electric aviation for everything from training planes to air taxis.

Nick: Today, we're sharing one story of someone who's helping to develop environmentally friendly electric helicopters to deliver transplantable human organs. Saving the whole world one life at a time. That's coming up on Air Space, presented by Olay

Music up and out

Emily: So the big motivation for electric vehicles, electric transportation of all flavors, is the friendliness to the environment. We all know global warming and climate change is a really big problem. It continues to be a problem and it continues to become a bigger and bigger problem as time goes on. And air travel especially is a really big contributor to this problem.

Matt: So the number actually sounds small, right? Air travel contributes about two to 3% of carbon emissions. But when you actually think about it, about all the related industries, all the ground transportation in and around planes, airplane fuel extraction and refining and just the carbon footprint of commercial airports, that number starts to climb. So converting to electric and finding sustainable sources for electric fuel, that could be a game changer in fighting climate change.

Nick: And there are a lot of people working in this space for all of those reasons. AirBus has an electric aerobatic plane that they're working on. A company in Sweden is working on a small propeller driven passenger plane that can go like short distances. And then there's an electric trainer aircraft to make it cheaper to learn to fly. And there are also countless companies that are

working on electric aircraft that we would think of as like flying cars. They're sometimes called EVTOLs, which stands for Electric Vertical Takeoff and Landing They're not quite helicopters, and they can act as air taxis or delivery vehicles for flying people and goods above traffic and relieve some of the congestion in cities. But today, we're going to talk about a straight up electric helicopter, you see what I did there?

Others laugh

Emily: Another way to envision an easy stall is essentially it can take off and land like a helicopter because it doesn't need a runway, but then it propels itself through the air more like an airplane, which is why it's sort of considered kind of a hybrid. It's sort of a mix of those two things, which is why they're really cool for futuristic taxiing systems and people transporters. You don't need runways spread across the country in order for these to work. But that's why they're kind of a hybrid mélange of technology.

Nick: The story that brings us here today has to do with precious, precious cargo that actually does not take up a ton of room or weigh a huge amount. We're talking about transplantable human organs. And one person who's been helping to solve the problem of electric aviation for delivery vehicles is Dr. Martine Rothblatt. You may have heard her name before as the inventor of Sirius XM and other innovations in satellite communications. As a thinker and writer about A.I. and Transhumanist, limb and in pioneering drug research for pulmonary hypertension. Today, we wanted to talk to her about her work in transplantable organs and how they could be delivered in the medium term future.

Dr. Martine Rothblatt: My name is Martine Rothblatt. I am passionate about aviation, and I currently I'm in charge of a biotechnology company called United Therapeutics. One of our activities is creating transplantable organs and we endeavor to deliver them with zero carbon footprint aircraft. And that has been my pathway into electric aviation.

Nick: Here's a here's my favorite bit about what Martine just explained, that it's not in the soundbite. She's working on artificial lungs. Lungs are the most vulnerable of transplantable organs. They're the ones that are the most difficult to get from place to place. She's working on ones that are 3D printed out of a fiber grown from modified *tobacco leaves*.
Let's just all take a moment and bask in the beautiful irony and justice in that.

Emily: Well, we're going to need to come up with something to do with all of these tobacco plants eventually when everybody else figures it out.

Matt: Well, you know, people don't realize this, but a lot of genetic research really owes its existence to tobacco leaves because they are just incredibly plentiful, genetically modifiable.

And there are viruses you can study that attack them. There's all kinds of things like it's all about fruit flies and tobacco leaves and occasionally corn.

Emily: *laughing* fruit flies and tobacco leaves

Matt: Can I say how impressed I would be, by the way, by like a 3D printed lung that worked because, you know, like an artificial heart. Right. It's just a pump. Anybody can do that, right? *Pff* Nothing special.

Emily laughs

Matt: But like the lungs the lungs perform such a complicated thing in the body in terms of blood flowing through them. Gas exchange happening between red blood cells and the air that you're taking into your lungs, like to make something like that work. That's like rocket science.

Nick: And the organs aren't ready yet. This is still future technology. They haven't they haven't gone to the FDA for approval. Just like the electric helicopter that they developed hasn't gone to the FAA for authorization and approval.

Emily: Well, and I think when you take into consideration all of the things, Martine has accomplished already and all of the things that her and her colleagues are trying to revolutionize, you put on top of all of that that she's a licensed helicopter pilot. And it was her first electric car that really got her little gray cells firing about how to maybe combine those two technologies, you know, electric transportation, with, you know, her interest in aviation and her skills as a pilot and sort of kicked off this whole idea of how do you combine your skills as a pilot and your interest in electric technologies to make, in this case, an electric helicopter.

Martine: After I got the spark for the idea by combining my Tesla with my belt for playing on helicopter, I work through these equations.

Nick: So it's worth talking a little bit before we turned it over to Martine for the physics of her project, how helicopters work as a principal. And it's also worth noting, life saving was the reason the helicopter was invented. Igor Sikorsky specifically wanted like a point to point rescue ability out of an aircraft. So that's why we did away with the wings in the first place. But helicopters work by beating the air into submission, you may have heard that. It's all about lift over drag ratios that are the basic physics at play here. As the rotors spin, it creates lift, the weight of the helicopter and the force of the air in the weather and other conditions is the drag and the force of the lift has to be greater than the force of the drag in order for the helicopter to fly.

Martine: And I determined that for the helicopters to go the distance needed to deliver our organs to hospitals, that they needed to have a lift over drag ratio of very close to 20. Much, much better than a typical helicopter. So to have a lift over drag ratio of close to 20, you cannot have the, something that looks like a helicopter or you have to have something that looks more like an aircraft. And furthermore the rotors that make it go up and down those rotors have to drop into the aircraft and not be dragging through the air as you're flying. So you need to have a propeller behind the aircraft, which we call a pusher prop, to push it horizontally. And then the vertical rotors that take you up and down, they are only in use for the short time that you're lifting off and landing.

Emily: So these electric helicopters essentially have rotors on the top, like a regular helicopter that it uses to take off and land like helicopters do. But when it's traveling through the air, it's doing it a lot more like an airplane.

Nick: As we pointed out at the top, there are a lot of companies working in this space. Solving electric aviation is so hot right now. And while that feels very futuristic, it actually parallels other leaps forward in aviation and aircraft technology. That happened when flight was first understood to be feasible and when helicopters were in development and then the jet age and then the space age. Really, it's all history repeating itself.

Martine: We are in a renaissance of aviation, very much like first there was in the 19-oughts when inspired by Wilbur and Orville Wright, everyone began trying to build airplanes and there were like literally over 100 airplane companies in the 19-oughts in the 19-teens. A similar renaissance of development occurred in the 1930s. That was for helicopters. Helicopters were like 20 years behind planes. That continued into the forties with the impetus of World War II. And then by the time of the Korean War in the fifties and the Vietnam War in the sixties, helicopters had really come into their own as a, as a mature technology. There really was no big change in helicopter design from the Vietnam era until this past four, four years, let's say. And now there's been this explosion of, of, of interest and passion with now over 100 companies trying to develop either electric helicopters or they might call them eVTOLs.

Nick: So the reason that helicopters are good for organ transportation is because you're talking about short and medium term distances. You're talking about from the airport to the hospital without having to get stuck in traffic. -*aside*- Atlanta--. And that application has a lot, a lot, a lot of benefit to everyone if we can perfect iy and get it into widespread use and make it cost effective.

Martine: One of the great advantages of helicopters is that we can go directly to the hospital and thereby avoid delays due to snow or other bad conditions on the roadways. Traffic jams Most

transplant hospitals, if not all, are in major metropolitan areas, most traffic jams are in major metropolitan areas. So helicopters just allow you to save a couple of hours. And, you know, for many patients and for many organs, every hour makes a big difference in terms of the viability of the organ and hence the lifesaving benefits for the patient.

Matt: So, I mean, this all sounds really cool and especially helpful if you need an organ transplant and you know, you're just waiting for your kidney and it hasn't arrived yet. But in terms of passengers, right, flying on electric helicopters and these things becoming more common. How does this all scale up? Like what are the kind of I don't know, the drawbacks, let's say to having a city that's completely gone in for what sometimes is referred to as urban air mobility? The idea that you could get from point A to point B in the city by bypassing roads, because I mean, we know there's already people who take helicopters from the top of their skyscraper in New York to the, to the Cape, to their second home or whatever. But what if we're all doing that? What if everybody is suddenly flying around in these things? How does that manifest?

Emily: Yeah, I mean, you may be taking congestion off the roads in cities, but if you're just putting all that congestion in the air, have you really solved the problem or you just translated that problem into a different space that also needs to be regulated and maintained? And I think at least initially, you'll certainly see the sort of unidirectional, like movement of congestion off of the roads and sort of dividing it between roads and the air and potentially reducing congestion, at least temporarily. But with new technologies come new problems. I mean, it may solve one problem, it may solve a few problems, and it'll be really interesting to see how the usage is are changed and regulated and modified to serve a purpose.

Nick: And Emily, you hit the nail on the head there. That's one of the reasons that electric aviation is so important to develop now, because even though it sounds like we're not offsetting a ton of the carbon footprint globally, what we're talking about has the potential to become a part of our everyday lives. If the costs get low enough and the technology becomes safe enough, then there is going to be a tremendous increase in air traffic. And if some or all of that traffic is electric, then it won't have the outsized impact that mass market automobiles had in triggering a cascading century of warming and greenhouse gas emissions. So I think that's one of the reasons that we're all so excited to talk about electric aviation isn't to cancel a very profound but seemingly small percentage of greenhouse gasses, it's because once we unlock it, it's going to be critical that it be sustainable. I think, in the future, thinking ahead.

Matt: Yeah, and I think it's definitely possible to think about all of the problems that could happen. And I tend to focus on problems when I think about these things. But also still be excited about this, that the future of a city might be a combination of, you know, traditional automobiles, but electrically powered, hopefully, and electrical helicopters and also at the same time, public

transportation that can move masses of people all at once from point A to point B, one does tend to think about the negative when one considers, for example, that when a solution to a congested highway is to build a new lane onto that highway and then what happens as a result is that freeway remains as congested as before, but with an extra lane for more traffic. One starts to wonder whether these problems really can be solved just by pushing people into different vehicles and doing different things.
But at the same time, I want that future. I don't want to stand in the way in that future, but I will stand here being negative about it anyway.

Martine: I think for the 2020s, this explosion of technology will occur. The best technology will win out in a kind of techno-Darwinism, if you will. And I believe that the latter half of the 20s, the early half of the 2030s will be the time that the FAA certifies the aircraft that it believes are the safest. And then in the 2030s we will begin to see as many electric aircraft in the sky as you see jet powered aircraft or propeller powered aircraft today.

Nick: So 3D printed lungs made of tobacco leaves, electric helicopters, both of these things are in the same boat at the moment. The technology is experimental, they're into the design and the testing and the regulation process. And if all goes well, someone in need of new lungs might get a transplantable organ, grown out of tobacco leaves, delivered to their hospital by an electric aircraft, maybe even in the next ten years. And in multiple different ways, isn't that just a breath of fresh air for all of us?

Music up and under

Matt: AirSpace is from the Smithsonian's National Air and Space Museum. It is produced by Katie Moyer and Jennifer Weingart, mixed by Tarek Fouda.

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