Sue Nelson
Hello, I'm Sue Nelson and thanks for joining me on Create the Future. A podcast brought to you by the Queen Elizabeth Prize for Engineering.
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Climate change is recognized as a serious threat to our environment, food security, and the global economy. And engineers around the world are playing a role in trying to mitigate the increase of greenhouse gases. My guest is the head of research and development for Climeworks, a company based in Zurich In Switzerland, that built and operated the world's first commercial direct air capture plant of carbon dioxide. Nathalie Casas is a chemical and bioengineer. She studied at the Science and Technology University, ETH Zurich, and worked at the industrial company Sulzer, before joining Climeworks in 2017. It's a company founded by engineers to reduce the effects of climate change. And considering we're all experiencing a current threat in the form of pandemic, I began by asking Natalie, how seriously we need to take climate change right now.

Nathalie Casas
From my point of view, and climate change is there, so even if we have another big issue to resolve for the moment, climate change will not vanish. So, it needs to be taken very seriously. And also, we don't have much time to lose. So, we know already since decades that climate change is happening, and we didn't really act on it. And now time is getting short, and we need to do something.

Sue Nelson
Do you see climate change as a specific challenge for engineers, for them to play a role in helping to determine the Earth's future?

Nathalie Casas
I think engineers can contribute quite a lot to the solution of climate change. Everybody needs to be aware of, and everybody needs to work against it or do his share. But I think the engineers have the opportunity to deliver technology in order to mitigate it. From this perspective, I think being an engineer, we are in a good position to help, also other people to make something against it.

Sue Nelson
So let's go to this direct air capture plant that Climeworks has built and operates. How do these actually work?

Nathalie Casas
There are different technologies around but the one we have, it's kind of a filter box, where we suck the air through, and the CO_2 sticks into the material in the box and can then be released by heating the box and collected in a concentrated form. So it's kind of a two-step process. First step, we get air into the box, we collect the CO_2 and then in a second step, we heat it up, CO_2 is released and can then be collected.

Sue Nelson
And how much carbon dioxide can a typical sort of plant remove each year from the air?

Nathalie Casas
So we have a very modular system. I don't know if you have seen the picture of our plant. So, one box is, lets say about 1.5 meter cube, and this cube can capture about 40 to 50 tonnes a year.

Sue Nelson
That's incredible.

Nathalie Casas
Yeah, it's quite a lot. So, if you compare it to trees, it's as efficient as 2000 trees per year.

Sue Nelson
That's a bit worrying to me, though. That's signals warning bells. Does this mean we'll have more boxes instead of forests?

Nathalie Casas
No, definitely not. So, I think we need to take care of our forests and we also need to plant trees. I'm absolutely not against trees and natural resources. But what I wanted to say is that our technology has also an edge, so we need less space, and less water in order to capture a really big amount.

Sue Nelson
I understand. And it's not just about reducing emissions though is it you actually store the carbon dioxide and then sell it on?

Nathalie Casas
Yes. So, there are two ways you can make use of this captured carbon dioxide. So, one thing is to store it underground. This means it it's separated from the atmosphere and actually removed. So, if we want to reduce the concentration in the air, this is what we have to do. The other thing is the circular economy, which gets more and more attention in the last years. What does this mean? So, a carbon which is in the air, so a CO_2 is captured and then transformed to material using electricity. For example, you have a CO_2, you capture it, you transform it into fuel, and then you burn the fuel and the CO_2 is released again. So, by doing this, the CO_2 concentration in here is not reduced. But you're not adding any CO_2 to the air.

Sue Nelson
Hence, the sort of circular side of it, it's just going round and round in circles. And you can also sell pure carbon dioxide to food and drink industry I'd imagine?

Nathalie Casas
Exactly. So, this is also something where we are doing now. So, we sell a CO_2 to a mineral water supplier being Valser, this belongs to Coca Cola, in order to create the bubbles in the drink.

Sue Nelson
Yes, I must admit, I'm a bit addicted to bubbles in sparkling water. I'm never 100% sure whether I'm doing the right thing for the environment or not by having one of those CO_2 canisters. But if it was to come from a sort of circular economy type method, then that would basically ease my conscience, wouldn't it?

Nathalie Casas
Yes, then you don't need to worry about the CO_2 in your sparkling water.

Sue Nelson
Good. Now your job as head of research and development, R&D, what is a typical day involve for you? Describe what you do?

Nathalie Casas
I'm a chemical engineer by background. So, what I do the whole day is basically meet the people in my team, I discuss their progress, I discuss their strategy, where do we want to focus on in the next weeks. How can we

improve our technology? And I'm more, I would say in a strategic role, however, quite close to the technology. Of course, I'm head of R&D, So I need to, and I really like to, but I'm not doing the engineering by myself.

Sue Nelson
So you're using your background in engineering, to spot the potential in other engineering projects effectively?

Nathalie Casas
Exactly. So, one thing is to spot potential and the other thing is to set a strategy and the direction for my people.

Sue Nelson
And can you tell if someone's project idea is likely to fail or succeed? Sort of immediately, or do they always take work?

Nathalie Casas
This is difficult to say. So, I think if they're trained people, their ideas normally are already well thought through. So, they're not coming up with very crazy ideas, which you can immediately tell that this would not work. So, I think normally, if a new idea is on the table, we set us, for example, two weeks to get a bit deeper into it, and to analyse the risk and upsides or the potential of the idea. And then we decide if we put more time and money on one or the other idea.

Sue Nelson
An are all the ideas that you're looking at all related to climate change?

Nathalie Casas
Yes, so the ideas I am looking at during my working day or in my job are all related to climate change, and even more precisely to DAC, so to our direct air capture technology.

Sue Nelson
And what sort of future do you see for this in terms of a time scale, for more countries to be using this technology?

Nathalie Casas
I think it will be deployed, and it will be deployed rather quickly, so I'm also talking to customers and giving speeches at conferences. And I realized that in the last year, so let's say the last two to three years, there is a really big momentum on the topic. So, more and more companies and also countries realized that there is a big need for action now. And they want to do something. Since direct air capture is one of the few technologies which can actually take out CO_2 off the air and reduce the CO_2 concentration. We have quite some attention and also a lot of support.

Sue Nelson
That's great. Now, let's go to your career. You studied Chemical Engineering at ETH Zurich. And that's, I was reading about it and it was saying, you know, it was established in 1855. Is this part of Switzerland's engineering establishment so to speak in terms of academia?

Nathalie Casas

Yes, so I think in Switzerland, there are two federal schools on a university level where you can study engineering. And this is the ETH where I studied and the EPFL in Lausanne. So, these are in terms of, let's say, ranking the two top universities in Switzerland, when it comes to engineering.

Sue Nelson
And how does Switzerland treat its engineers? One of the things about this podcast I found quite interesting is engineers from different countries often have different viewpoints. And so, say, in India, engineering was always considered like a sort of admirable, “this is the profession you want your children to go into”. How was it in Switzerland?

Nathalie Casas
I would say it's also one of these professions you would like your children to work on or go to, since it's a very solid and profound education. And there are not enough engineers here in Switzerland. So, getting a job is not that difficult. Since there is a lack of engineers there are many engineers coming from outside, so from Germany, or France, or Italy, Spain, to support our industry. And there is quite some tradition in engineering in Switzerland as well.

Sue Nelson
Yes, absolutely. My mind immediately went to clocks, which is such a cliche, but couldn't help it. I'm sure there's far more to it than that. I just thought, “oh, precision watches”. Why chemical engineering though? What led you to make that choice at school to study further?

Nathalie Casas
I think I was quite open. So, I was always interested in engineering, in chemistry, in biology, and material science. So, my father is an engineer, a mechanical engineer. And my mom is a microbiologist. And I remember when I was a kid, my mom had to go to work sometimes on the weekends. And when my father was traveling, I went with her. And then she allowed me to do some microscopic experiments, or to mix some things in the lab. And this I really liked. So, from early on, I was very fascinated, on the one hand, by engineering, by math, and on the other hand, also by the work you can do in the lab, and by really little things. So, I think it was kind of a compromise of my background.

Sue Nelson
That's really lucky, actually, isn't it? Effectively having your parents as mentors. And also, in a way, it's like an informal internship, too, because, like you say you're getting to see engineering from the inside, from a very young age?

Nathalie Casas
Yes, so I really enjoyed it. And also my father, he loved engineering. He was very passionate, and he was discussing things with me, explaining how things work. And we also often went to museums so when we went to Paris, we went to The Cité des Sciences, and I really loved this with all this experimental setups and explanatory exhibitions.

Sue Nelson
It's a lovely museum that actually, I agree. It's really, really good! And you did a masters and a PhD. And from there, you went to work at Sulzer an industrial company I mentioned earlier in the introduction, as something called an Application Manager, what is an Application Manager?

Nathalie Casas

I think there are many different application managers in the job sphere, but at Sulzer as an Application Manager I was responsible for technology or a process and in my case, so I was responsible for several processes, but one of them was the CO_2 capture. This means that in the area I was responsible for, which was a Europe, Russia, India, and Africa, all customers looking at these technologies were talking to me. So, I had to help them to find a good solution a good process for their problem. And I also had to understand their needs. So, if a customer has a specific problem, which we could solve with a specific product, I had to bring this into the R&D department and discuss with them how we could develop this. So, this was very interesting and also diverse job. So, at the interface between R&D and the customers.

Sue Nelson
I can see how that leads perfectly to your current job, what did you learn then while you were at Sulzer? What would you say were the sort of lessons that really stood you in good stead for working as head of R&D now?

Nathalie Casas
One thing I learned, so coming from academia, after four and a half years of PhD, I was really technology driven. And I always thought, okay, the best technology will make it. And then if you get released, let's say, to the real world, I had to realize that sometimes something is best from a technological point of view, but the customer is not interested. Maybe it's too expensive, maybe it's too fragile, maybe it's too complex. And I think I learned a great deal of pragmatism. I really learned to find like a compromise between technology and also needs of customers, or the need of the product.

Sue Nelson
It sounds to me like a logical progression, then for you to want to go to Climeworks as head of R&D. Was it as simple as that?

Nathalie Casas
Yes. So, I think my reasoning was a bit on the CO_2 capture. So, I did my PhD on CO_2 capture, so by means of absorption. And after my PhD, I really wanted to have my ideas and my designs being built. So, I really wanted to have something out there, which is big, which you can look at, and see that all the thoughts you have put into it, are actually being put in place. And then after several years, at Sulzer, I realized that I was a really small, small part of a big conglomerate. And that my ideas might be good, but might also not be implemented because there are too many people giving their opinions or making decisions. So, going back to smaller company, like Climeworks, which is a start-up I can have much more to say or I can much more contribute to the shape and the way things are done was really appealing to me.

Sue Nelson
And you mentioned Climeworks being a start-up, and this is a start-up set up by ETH Zurich. It’s lovely that you've come back full circle?

Nathalie Casas
Yeah, the two founders, Christoph Gebald and Jan Wurzbacher, they were doing their PhD at the same time as myself at ETH, I think in the same building, but not on the same floor. So, I knew them from sight. And I was in contact, let's say in loose contact with them throughout the last years also when I was working at Sulzer, and we had quite some discussions if I should join them or not. And after this four and a half, five years at Sulzer, I really felt that now's the time. That I would like to join.

Sue Nelson

It's not just a young company then, it's also a relatively young team of engineers working on it, which sort of complements the fact that we're dealing with, in terms of operationally, a young technology?

Nathalie Casas
We are a very young team and the company, we had the 10th anniversary last year, so it's not that young anymore, but still. When it comes to the technology, I would say a big part of it is not really a new technology, but the combination of all of it and some parts of it are really a new technology, as you mentioned.

Sue Nelson
And now that everybody's having to work in a different way. You know, here we are doing our interview remotely using Zoom. How has your work changed during the pandemic?

Nathalie Casas
So my personal work, I think I was working, or I was always sitting in a lot in meetings and have a lot of chats with people. So now I'm sitting in the home office, and I still have a lot of meetings and a lot of chats with people.

Sue Nelson
Just not face to face.

Nathalie Casas
Just not face to face, I think it's a bit more exhausting, because you need to really make the effort to contact the people, you don't meet them in the corridor. So, all this social interaction is not there. So, this is, I would say, for me that the biggest impact I have. The actual work which I need to do, I can do perfectly from home. So in this respect, I don't have that much changes.

Sue Nelson
And what would your advice be to younger engineers or those thinking about studying engineering? What would you say they should either consider or think about in terms of personality or ideas or technology? What would it be? I often advise people who are thinking about doing journalism for instance, in terms of is it really what you love doing? Because if you don't, and you don’t persist, you don't take the knockbacks, you will find it really difficult. You know, it could be anything.

Nathalie Casas
That’s a good point. So, I had an interview with ‘1% Engineer’ some time ago, and they asked me a similar question. And what I said is that I think you should do something you're passionate about irrespective of what you're doing, because if you're passionate about something, you are also good at it, normally, or you are really eager to spend time to get really good. And I think engineering, it's hard. And it's a hard education. So, you need to study a lot. At least we have to do this at ETH, and I guess most engineering schools are more or less the same. It's pretty time consuming. And you really need to have the passion for it. If you don't have it, then it might get a bit tough and also consuming.

Sue Nelson
Yeah, I think you're right about that the hard work as well, I think. My son is studying engineering and even with no lab work at the moment because of pandemic restrictions him and his fellow engineering students are still working really, really hard. It's a lot of hard work. So how do you relax then?

Nathalie Casas

So, I love spending time with friends and family, and I really like to go outside. So here in Zurich, we have a wonderful lake. So, I do sailing, so I love to be on the lake in the lake around the lake. So, this is for me a perfect way to recharge my batteries and to get my mind free of all the thoughts I had during the week.

Sue Nelson
That sounds absolutely perfect. And I also like the fact that as a technology that you're working on, which is you know helping our climate and clearing the air. It's the one thing you do associate with Switzerland as well, is beautiful, clean air. Nathalie Casas, thank you very much for joining me on the Create the Future podcast.
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