S02E02: Plant Power for Electricity

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Kyle Fox (00:32):

This is the Smarter World Podcast, focusing on breakthrough technologies that make our connected world better, safer, and more secure. I'm host Kyle Fox. Each episode we introduce bright minds and their approach to a more sustainable world. We discuss the opportunities and the challenges they face and how technology can change the world for the better. Today I'm delighted to be joined by Marjolein Helder, CEO of Plant-e, a startup based in the Netherlands, in Europe that generates electricity with living plants and is the only known company in the world that generates carbon negative electricity. Welcome.

Marjolein Helder (01:07):

Thank you.

Kyle Fox (01:08):

All right, before we dive into it, Plant-e's technology is very exciting with huge potential but before we dive in, can you tell us a little bit more about you, Plant-e and what brought you to this?

Marjolein Helder (01:15):

I'm founder and CEO of the company, Plant-e, and I started the company based on my PhD research I did a few years ago at Wageningen University. So one of the university professors actually thought of the idea to produce electricity with living plants and I was one of the lucky researchers to start working on that project and I wanted to bring the technology to the market as fast as possible and that's why I already founded the company while I was doing my PhD so that we could get the technology out of the lab and into the real world really quickly.

Kyle Fox (01:50):

Incredible. So doing a startup while you're doing your PhD. So you say that Plant-e is the only known company in the world that generates carbon negative electricity. I love that term, so powerful, but carbon negative electricity, what does that actually mean? Can you explain that a little bit more?

Marjolein Helder (02:04):

Yeah, so it actually means that we capture more carbon during our process of producing electricity than is emitted. Now we all know carbon neutral technologies where no CO2 is emitted during the process, but actually we capture CO2 while we are generating electricity. So let me shortly dive into the technology and how that works.

(02:29):

So a plant generates organic matter through photosynthesis, so it captures CO2 and then makes organic matter out of that. Now part of the organic matter is used for its own growth and part is excreted into the soil where bacteria breakdown the organic matter and in that breakdown process they release electrons and we are using these electrons to actually generate electricity from. Because we generate electricity while the plant keeps on growing, the plant continuously captures CO2 and we generate electricity.

Kyle Fox (03:04):

That creates an amazing positive feedback loop. I know of no other technology that produces power and can provide sustenance and helps with reducing global warming emissions all in one go. What I loved about your TED talk that you did was the opening. You put up pictures of fields of green and you say, what do I see? I see electricity. And once I heard that my eyes really opened up and as I was driving around, I started seeing the very same thing. Fields of green, especially around where I live, and realizing that every single one of those fields could be a potential for generating electricity and the potential is extraordinary. So I'll ask the tough question now. Producing electricity by plants and water could, to some people, sound too good to be true and I'm curious, how do you actually instantiate it in a small area and then grow it?

Marjolein Helder (03:45):

That's indeed a very tough question. So the TED talk you watched was actually from 2014 and in that time we still thought that we would be able to scale up to indeed like hectare size systems that would generate electricity on a very large scale so that indeed the power plant of the future would look like a wetland. That was the vision that we started with, but we have to be very realistic. It is really tough to work with nature and work with biology so we found out that right now it's still impossible to scale up to such an extent. So what we're now doing is actually down scaling to standalone, low power systems where we can generate electricity and use it very effectively.

(04:32):

So in that way we actually avoid the scale up challenge while we can, at the same time, already generate electricity on small scale but with a very high impact. For example, powering IoT devices, sensors in agriculture or in urban environments or in nature. Nowadays these sensors are all powered by batteries normally, and batteries need to be replaced regularly. They generate quite a lot of chemical waste in the end. So if we can avoid those batteries, we can and

replace those batteries by a plant power system, we avoid lots of chemical waste and we make it much more sustainable and durable to power these sensors.

Kyle Fox (05:17):

So you made the statement about Plant-e and IoT. In NXP, we sell a lot of different technology solutions into the IoT space. Can you elaborate a little bit more about the connection between Plant-e and NXP?

Marjolein Helder (05:27):

Yes, of course. When we started bringing our technology to the market, we actually thought it would be pretty easy to connect an application, whatever it would be to our power source so we thought this is a power source like any else. So we can just replace the battery by a plant system and then make that same application work. Practice is a bit different and the main reason is that our biological system is not only a power source but can be a battery as well and it has a very large impedance, so it has a very high internal resistance and that delivers all kinds of problems when you actually want to extract the energy out of that. And we worked our way around it using bits and pieces that we could find on the market and small chips that sort of did the job for us.

(06:20):

They were effective but not ideal. And then at a certain point we ran into someone of NXP who basically said, "Oh, we can do that so much faster and better and easier for you, so we'll develop a dedicated bio electricity harvester for you so that you can actually use that to power all kinds of applications." And then half a year into the collaboration, I remember one of the guys of NXP telling me "This has proven to be way more difficult than we thought." So even though it was a setback in terms of a development time, it was a compliment as well because it meant that we hadn't done the completely wrong thing before. It indeed was more difficult than everyone anticipated. Having said that, we have collaborated for almost two years in trying to develop a dedicated bioenergy harvester and at the same time proving this in a pilot project with one of the water boards in the Netherlands for a groundwater level sensor.

(07:24):

And we have managed to do that and we presented that at CES in beginning of 2022, and that was a kickstart to our IoT use cases and our IoT business development so it has definitely helped us that we had this collaboration with NXP because it gives lots of credibility. Being able to tell others that's what we developed together with NXP, that gives you a lot of credibility as of where you would do that by yourself as a startup, people are like, so how good is that stuff? And now no one questions the level of expertise in our electronics actually.

Kyle Fox (08:03):

Well that's fantastic. We spend a lot of time with our solutions to focus on low power and this is one of the more important examples of where somebody like Plant-e is able to take advantage

of it and the technologist in me immediately starts thinking, you put a microprocessor in front of something and you can power it, you start opening up use cases that you never even considered because you actually have the ability to process information and provide it out to the world and that's where you get these feedback loops of innovation that come from it because you've put intelligence literally at this point, right at the edge, right next to a plant and a bio-energy harvester, and actually a note to our listeners, I was at CES earlier in January of 2022, there are several videos showing the Plant-e technology so I recommend you go check those links out and see that and see that kickstart in action.

(08:49):

So the picture in my head that you're drawing is lots of smaller instantiations scattered throughout perhaps a city, right? Whether it's in an airport or in a park or whatnot, you're basically just needing some land to be able to grow plants to be able to generate that electricity.

Marjolein Helder (09:01):

Indeed.

Kyle Fox (09:02):

I come from a family of farmers and even here in the US, the importance the electronics have in a farming community, even in rural spaces, the ability to have a small plot of land that can actually generate electricity is huge. We could use that immediately. So you said that you have some challenges to be able to scale this up. I also remember you mentioning that there are approximately 1.7 billion of people that are without electricity. That's something like 20% of the global population. Do you feel that bio electricity is something that we will do for the future? Is it something we can scale up or is that something that we can implement on a global scale commercially?

Marjolein Helder (09:33):

Yes, I would definitely hope so. We're currently not at that level yet, but that's definitely what I'm striving for. I believe that indeed this technology has way more impact on those people who don't have access to electricity yet rather than in western developed countries where everything is already electrified. At the same time, we have decided to start marketing our technology in developed countries where people are able to pay a bit of a higher price rather than in developing countries where price is definitely an issue still because this is unique, innovative technology, it's still under development, so prices are still relatively high, but as soon as we reach a fairly large scale of production, then prices will definitely drop and then it becomes available to developing countries and developing communities. And my personal mission would be to deliver it to those people who need it most.

(10:31):

Now, if you already have electricity from the grid, having a little bit of electricity powered by plants, that gives you extra light or an extra sensor, it is just fun to have but if you don't have

any electricity yet, this could be a real big difference to your life and, for example, I have been to the Amazon rainforest where I found a huge solar panel in the middle of the forest, completely overgrown and the indigenous tribe who was living there, they told me, "Well, yeah, we got this from the government, but it's not working." I said, "That's not a surprise because it needs sun." And they were like, "We just don't know how to fix it." And that's the whole thing. So the poorest and the most remote communities in the world don't have the technical skill mostly to obtain technical products.

(11:21):

Now that's the difference with the biological product. So in rural communities and very remote communities, everyone knows how to grow a plant so if we can help them grow that plant and at the same time generate electricity so that they can have light to read by at night or indeed have a sensor that tells them how much fertilizer that crop needs, that makes a big difference.

Kyle Fox (11:45):

What you're describing is something, it can make a big difference to their way of life. The picture that you're describing is extraordinary and I never really thought about it that way in terms of we have high tech solutions to power, but the ability for this to be deployed into an area that doesn't have that technology base, your solution is perfect. And you said it best if you know how to grow a plant, you can use this. So its barrier to entry to use it is quite low.

Marjolein Helder (12:10):

Yeah, indeed. At least it should be. So as I said, the technology is still developing, so we still need to make it fully plug and play. We're very much looking forward to actually deploying this in those places where it's needed most. Yeah.

Kyle Fox (12:23):

I'm quite good at killing plants. I don't have a green thumb by any means, but I was thinking about sensors in the home so if we're actually growing food for ourselves, then the ability to have a sensor that lets me know if the plant's thirsty and that sort of thing would be very beneficial in my own home. And when you're describing some of the challenges that you have about scaling, what I heard was high tech is quite good once you get movement to reduce costs over time. As new versions come out, new technologies, new breakthroughs and getting economies of scale, what are one or two things that you would like to do, and some of our listeners could help contribute to this to help get this onto that cycle? What else could we do to help you accomplish your mission?

Marjolein Helder (13:00):

Wow, that's a good question. I think there's two things that will help us scale. One is we need credible investors that have a long-term vision and that they're to invest in something that's a moonshot maybe and it feels like that for most people. And even though the investment

landscape in Europe is changing, still most of the very innovative investors are actually coming from the US so we still see quite a big discrepancy between investors in the US and in Europe. So that's one.

(13:33):

And then the second one is we're looking for launching customers for the two products that we already have on the market. The one is a lighting system, so standalone for example, for parks to have a little bit of light in a very dark corners of a park powered by the plants that already grow there. So the grass that you walk on. And the other product is our IoT product, which is still under development, so groundwater level sensors, soil moisture sensors. If we would be able to find customers for these early stage products at still a premium price, that would be awesome because it actually helps us validate our products and at the same time develop the technology.

Kyle Fox (14:13):

When I think customer, it would be something like me as a homeowner, would I be a customer or would this be more of an institution or a company that would be a customer in your mind?

Marjolein Helder (14:21):

So most of our early stage customers have been governments, municipalities, councils, provinces, even ministries who wanted validated technologies, see that it works, show it off to the inhabitants of a city. That was at a stage where the products were still under development so for the lighting product, nowadays we mainly see it adopted again by cities for, as I said, for parks for example, but it could be rural pathways as well.

(14:49):

Have a little bit of light there where there's not a power cable, like standalone lighting by the plants that are growing there anyway so that's an option. We would love to have a product for consumers, but right now it's really difficult for us to actually deliver the services that comes with selling a product to individual consumers because if something goes wrong with one large corporate or government customer, then we have one [inaudible 00:15:16] to answer to. Now if we start selling a consumer product on a large scale and something goes wrong, we might have to answer a thousand of them. Now that's a challenge as a startup company. At the same time, I would love to take up the challenge if we feel that there's a product at a price range that would be attractive to individual consumers. However, currently I'm not quite sure we're there yet.

Kyle Fox (15:40):

It's interesting when you talked about a moonshot, I'm a bit of a space geek, so one of the very first thoughts I had was this stuff would look really good inside of a space station or if we ever get to a moon base, actually having living plants, being able to feed astronauts is quite a big deal and being able to generate electricity at the same time would be quite useful. It'd be quite

interesting to see if there would be a moonshot option there, quite literally. So before we close, I'll just ask, what do you envision the world looking like 50 years from now?

Marjolein Helder (16:07):

Ooh, quite different from now. I think we're at this point in time where we see that changes are definitely needed. So we see the vulnerability of our planet, of our climate system. So things are shifting already. Climate is getting more and more extreme in the places where we live so we need to do something to mitigate the effects of climate change, adapt to it but at the same time, we need to rethink how we live and how we use our knowledge and our technologies. And I think that bio technologies could be at least part of the answer. So the idea behind using living plants to generate electricity is that we balance it out with the natural system. So we never over ask the bacteria in the soil who are the ones that are actually generating the electricity for us, but because if we ask too much from them, the system collapses and the power production stops.

(17:07):

And I think this is a perfect example of what's wrong with our current system. We just want to continue to produce more and more and we've over-asked our planet, we have gone over the boundaries of what's actually possible. And if we've learned to get the system back into a balance, into a stable equilibrium, that would be awesome and I think this type of technologies, like the one we are working on is a very good example that it is actually possible to generate stuff with nature rather than from nature. And I think that's a very important lesson.

Kyle Fox (17:47):

It's so powerful and it has been an absolute delight talking with you today. What you're doing with Plant-e looks like it has a potential to change the world, which makes you one of the world changers. So I encourage everybody that is listening to this to go check out Plant-e. Take some time and learn about that technology and see what you can do to contribute. With that, we're going to go ahead and close our podcast. Thank you so much, Marjolein, for being with us today, and we look forward to talking to you in the near future.

Marjolein Helder (18:11):

Thank you very much.

Kyle Fox (18:12):

Thanks everybody for listening, and we will see you next time.