

[00:00:00] **Tamsin:** Welcome to Beyond Boundaries from the University of Aberdeen.

Swathi: Tamsin, do you worry about climate crisis?

Tamsin: Of course. It's difficult to ignore. And I do try to do what I can as an individual. Recycling, using public transport when I can, occasionally I cycle to work. But I think it's also clear that things need to change on a much, much bigger scale, society wide scale. Things like, how do we generate energy? How we travel? How we build our homes?

[00:00:30] **Swathi:** Definitely. I'm Swathi...

Tamsin: ... and I'm Tamsin. And in this episode, we're talking about all of that. And what better place to have this conversation than here in Aberdeen, the energy capital of Europe.

[00:00:42] **Dr Alfonso Martinez-Felipe:** Hello, my name is Alf Martinez-Felipe, and I'm a senior lecturer in chemical engineering here at the University of Aberdeen.

[00:00:50] **Tamsin:** What's your specialty then, at the uni?

[00:00:52] **Dr Alfonso Martinez-Felipe:** So I am teaching and doing research on the energy transition remit. And that means hydrogen projects, but also social implications of these new renewable energy projects around the area, trying to connect colleagues with companies, students with employees as well, and obviously doing a lot of teaching as well to get the new skills that are necessary for the energy transition to happen.

[00:01:20] **Tamsin:** So tell us more about the energy transition?

[00:01:22] **Dr Alfonso Martinez-Felipe:** Well, the energy transition is a process. Actually, it's just moving away from fossil fuels dependence, and trying to get energy sources and materials which are more sustainable, that don't depend on oil and gas, so that we can actually reduce emissions associated with that, CO₂, and then reduce global warming, which is coming to a very frightening point. The ambition is that at least in the UK and Scotland, we get to a net-zero sort of economy and society by 2050, but that cannot happen just overnight. So we need a process there. We need to do a lot of effort.

We need to change the way we use the energy. We need to change the way we produce the energy. And this is not only about the technical aspects, but it's also about, you know, being aware that we need to think about how we live our lives.

[00:02:17] **Tamsin:** So what sort of things does that mean we need to be changing then? What are you working on that will help with that transition?

[00:02:23] **Dr Alfonso Martinez-Felipe:** So technically we work on new technologies. For example, we try to find more efficient ways to produce new fuels that don't depend on gas or oil, and also ways to capture CO₂, for example, that could mitigate some of the emissions that we're going to have, uh, inevitable, but, uh, at the same time, working with companies to see more efficient ways to organise the different blocks in this very complex scenario, for example, renewable energies, are variable with time and place.

That means that we don't really know exactly when they're going to be generated, like wind, for example. Well, in Aberdeen, we do have a little wind, but it's going to change in time and direction. But at the same time, we need to make sure that the people can use that energy when they need it. So there are so many steps in between where the energy is generated initially, and then when it's going to be used, that there's so many parts that need to be defined. So my job, as well as that of my colleagues here, is to study those little systems, which are like little Lego blocks, put them together in the best way possible so that we can make it cheaper and more efficient for everyone.

[00:03:46] **Tamsin:** You mentioned hydrogen there. What things do you think will run on hydrogen in the future? What's your own personal thoughts on where we're going with all that?

[00:03:54] **Dr Alfonso Martinez-Felipe:** Well, that's a really good question. So hydrogen. It's going to be useful when we can obtain it cheaply without compromising other resources. I think transport in hydrogen cars and buses is already a reality.

I mean, if you try to go to the supermarket here in Aberdeen, you're going to ride on a hydrogen-fuelled bus probably. And you won't notice a difference, but you're making a big difference because you're not generating emissions in your trip.

And then there are different sectors where hydrogen can be used intensively.

Like for example, those places where it's difficult to use electrical power. I'm thinking about industrial heating when there is a possibility to use boilers that run on hydrogen instead of natural gas and potentially as well, hydrogen is an excellent feedstock to generate all the molecules. So if you could get hydrogen from green sources combined with other molecules like carbon dioxide, you could create new molecules that could be used as a fuel like methanol, ethanol and other more complex molecules.

And those could be used in transportation or to generate electricity or heat. And that is the kind of good thing about hydrogen, it's very versatile.

[00:05:23] **Tamsin:** So what are some of the hydrogen projects that you've recently worked on or been involved in?

[00:05:27] **Dr Alfonso Martinez-Felipe:** We are really fortunate here in Aberdeen Uni because we have a multidisciplinary approach on how we look at research.

So we got plenty of praise in engineering, about technologies for water electrolysis, which is generating hydrogen from water. And that means, uh, defining and designing and manufacturing new materials that can help the process to be more efficient and cheaper. But we also have a lot of colleagues working on safety of hydrogen and defining, again, the standards for hydrogen transport or hydrogen storage, which is something really important so that we make sure that obviously, this is reliable from the user point-of-view. We also have colleagues, uh, and myself working on using AI for hydrogen control and training. It is very relevant as well for companies that are going to invest money on that. And fantastic job done in chemistry, for example, on new materials for, uh, water splitting or using salt water, for example, for producing hydrogen, you know, straight from, from the sea.

But we also have colleagues in, in the School of Law working on regulatory aspects. So what do we need to make sure that if we trade hydrogen, it's actually profitable and it's legal. And I think one of the great, uh, aspects of the work we do in Aberdeen is that we know what each other is doing.

And, and that's important because. When it comes to the energy transition, and hydrogen specifically, you need to look at the different angles of the research you're doing.

[00:07:10] **Swathi:** That all sounds really exciting. But surely, reaching net zero can't just be about developing new technology. We also need to be supported to change the way we live.

[00:07:20] **Dr Alfonso Martinez-Felipe:** As you say, it's just um, looking at what habits we need to change. We are going to become, rather than just consumers of energy, we are going to become 'prosumers' because we will probably produce part of the energy if we have access to solar panels or the batteries, for example, to store the energy we get from the grid and then sell it later on.

So we need to educate everyone on the needs for this happening, but also on what are the possibilities out there. And that's particularly important because we might see the energy transition as something really technical. But indeed, it starts with the way we use the car every day. Or we pick up to walk, or we can use public transportation, or we just share cars, stuff like that.

Transport is just one thing. So the houses need to be insulated to avoid energy losses. And this is very important as well, because you could be pumping energy all the time and still be losing a lot of money and a lot of efficiency in the process.

[00:08:26] **Tamsin:** As you might know there's been a longstanding commitment for the UK to reach net zero by 2050, while the Scottish government has promised to get emissions to net zero by 2045.

Swathi: And that's actually not that far off.

Tamsin: With 2045 and 2050 being so soon, realistically, the next generation of engineers and the next generation of our society are going to be the ones that push for all these changes. What do you think it will look like for them? What major changes need to happen?

[00:08:57] **Dr Alfonso Martinez-Felipe:** Because it's a process, I think we are going to see changes, but the landscape is not going to be as transformative as some people may have in mind. And that's why it's so important to actually act on that. Because there is a big interest you see in just keeping doing the same.

And I think people don't really see the effects until they are knock on their doors. Like floodings, uh, heat waves. I would say our worst enemy here is ourselves because there's so much political uncertainty, and it's normal because every country has its own business and, and things that happen thousands of

miles away are having an effect on the way, that's repercussion on, on our economies.

You just look at, you know, what's happening in the UK, for example, with, with budgets and, and with the winter approaching and people, you know, having to pay the bills. So I think the main threat for this to happen is for us to miss the big picture. And that's why we need to make progress fast so that people can see the benefits and can understand that this can be doable, but it's going to take time.

I think 2050 is very optimistic. I don't think it's feasible at the rate we are working now. And that's why so many people are actually saying we need to do more. But I'm also realistic. And as an engineer, I understand, first of all, the time that these projects require for planning and the stakeholders that are involved, particularly if we want to make it right.

And we need to engage with the communities. And I also see the resources that we need to. You know, involve in terms of, um, planning, infrastructure, capabilities, skills, all this is huge at a global level, but even on the Scottish and the UK level is a big effort. And I think we're setting up the scene correctly, but we're not doing as much as we should.

So as citizens, what we can do is play our part. But I think there's a lot to be done in the University, for example, to get You know, generate this new generation of, of engineers and, and graduates that understand the complexity of what's happening. And we need a lot of hands to do that.

[00:11:21] **Tamsin:** You mentioned the oil and gas industry, which was obviously important historically in Aberdeen especially. How is that going to have to change for 2045 and 2050 targets for net zero? Is that an aspect that hydrogen is going to be involved in again, because as you mentioned, it's going to hit every aspect of our society from our homes to our companies and our workplaces and our cars, our travel, just everything. So is it going to affect industries like that as well?

[00:11:48] **Dr Alfonso Martinez-Felipe:** Absolutely. I think the oil and gas sector has to adapt as well as any other sector. And probably what we can see is a shift from oil and gas companies to Uh, global energy companies, because the infrastructure and the skills that we are going to need and we are needing for these projects are eventually recyclable.

And um, these big companies have been using, you know, a lot of knowledge and developing a lot of technology over the last decades. And this technology can be transferred into this energy - new really challenging projects and challenges. And in this sense, it's about using the opportunity that we have, particularly here in Scotland and in the North Sea to leverage on, on what has been there.

For example. We got a project where we are studying where we could use oil and gas platforms that are going to be decommissioned soon, to produce hydrogen or to be used for renewable energy generation. And we have a really good link to what's happening in the offshore wind sector too, because there are so many wind farms that are going to start producing electricity soon.

And we can use that electricity to produce something else if we need. or just bring it to shore. So the opportunities around the oil and gas sectors are, are huge. But I think that there needs still to be a, a change in the way that we perceive energy. And it's not going to be about someone produces the energy, someone else uses the energy, but rather there's going to be an inter- or a kind of two way, you know, exchange of energy with people generating their own power.

[00:13:33] **Tamsin:** From the '70s onwards, Aberdeen's been Europe's oil and gas capital. So is it going to change and become a hub for renewable energy, do you think?

[00:13:43] **Dr Alfonso Martinez-Felipe:** Well, it is already happening. I mean, in terms, for example, of hydrogen, Aberdeen is a pioneering city. I think it's probably the first city in Europe to have a fleet of hydrogen buses running.

And, uh, there are not so many other places in the world where we can say that we have two hydrogen production sites in the city. And this is just an example. We need to use our fantastic natural resources without exploding them, but using them to make the best of, of the wind we have of, of the water we have, but again, looking into the implications, you can't imagine the amount of, of companies and associations that are actually looking to achieve that.

I don't know if, if you're familiar to the Energy Transition Zone, ETZ, but that's a non for profit group company that are building different campuses in the south part of Aberdeen and what they're doing is they're transforming the way that we use the energy with different projects are helping companies to, to start new renewable energy projects and they're building facilities to test some of the new

technologies here in Aberdeen and, and then connect to the port as well, which will become definitely a hub for, for energy exchange.

We can think about using, again, the wind to generate electricity and that electricity are now green electrons we can use to generate hydrogen or other fuels like ammonia, for example, that can be used by ourselves or can be exported and we become an energy exporter as well through pipelines or vessels, not only to the UK, but to the rest of Europe.

But I think the way these projects are going and the complexity of the project. We'll involve that we cannot do it alone. I think we need to work in collaboration with our neighbours, first of all. And I'm thinking, for example, about Norway, which has a very similar kind of scenery, if you want, oil and gas producer for decades, now looking for a fresh start.

Denmark, um, obviously the rest of the UK, but, but also continental Europe, because the way we are going to consume energy and produce energy is going to be so much interlinked that we need to take this as a global problem.

[00:16:13] **Tamsin:** So with that in mind, of it being a global issue, the next generation of engineers are going to be quite pivotal in changing our society, along with all the other interdisciplinary areas. How can people get into a career like that?

[00:16:26] **Dr Alfonso Martinez-Felipe:** I think the good thing about Aberdeen Uni is, uh, we might not be a huge university, but we do have a lot of disciplines. So you can study engineering and become a really high technical, uh, worker or even a manager in, in these sorts of projects, but you could also study law and become an expert on energy law. And we have a centre that actually works specifically on projects related to the energy, but we need money as well to make this happen. So you can go to the Business School, and then do a Masters, well, obviously undergraduate career or a Masters on, on energy business and understand, you know, the, the different mechanisms to make it a viable from the economic point of view.

And I think that the good aspects of, of this university is that at the end of the day, you're going to need a little bit of everything. So even if you are focused on a specific area, you're going to have access to other, other teachers, and you're going to have access to other companies that are involved by scholarships, uh, visits to different sites that all of these projects are happening, and, and also lab work, and, and potentially joining teams that could work on some specific initiatives on particular vulnerable areas.

[00:17:53] **Tamsin:** For people who are interested in the engineering side of things, what courses can they take. Say if they've just left school, what could they do at Aberdeen to, to build on their ambitions?

[00:18:03] **Dr Alfonso Martinez-Felipe:** Well, as I said at the introduction, I'm a chemical engineer, so definitely Chemical Engineering is, is very relevant because, as I said, most of the processes are taking place, most of the equations, most of the skills are transferable to almost any chemical discipline.

So producing hydrogen, for example, It uses similar materials technology, so comparable to classic, um, reactions that are happening already. But, uh, if you want to focus on the material side, you could study mechanical engineering. And then, um, look into how good the materials need to be for this sort of projects.

And if you want to study the environmental impact of, uh, what we're doing and, and how to design the projects in a way that it's, uh, sustainable, then you can study Civil and Sustainable Engineering. But this is, you know, this is equally right for any other disciplines. For example, you can go to the School of Geosciences and, and have some expertise on water resources because we're going to need a lot of water as well involved in the processes that are going to take place.

Or study the geomechanics and how the soil performs when you're trying to inject carbon dioxide to capture the carbon that is being produced, which is another really high topic here in Aberdeen, and there's a huge project that's called the Acorn Project, just 30 miles away from Aberdeen, where Storegga is going to start pumping CO₂ into depleted oil fields, well, more or less. And that's a way in which we use the technology and the knowledge we develop in the university for renewable projects.

[00:19:42] **Tamsin:** And then once people have an undergrad in engineering or something, a subject similar to that, they can come to you and get taught for their, their Master's, right?

[00:19:51] **Dr Alfonso Martinez-Felipe:** Yeah, of course. I mean, if you're spent four years here, you want to spend another one more because it's a fantastic place to be. I think we do have a lot of people who stay after their undergraduate because they, they like the place, they are familiar, they know the opportunities and the, the MSc, which is a postgraduate extra year gives them a very specific focus on where they want to go. And we got people jumping from schools. For example, I'm the coordinator in a Master's for Energy Transition

Systems and Technologies in Engineering, but we have, uh, students coming from another graduate degree on Geography. Because these Masters are so interdisciplinary, what we find out is that we can give them different tools to speed up to the technical side, but also complementary skills to understand things like the economics and the social impact of the projects we're doing.

At the end of the day, I guess that when the students start to learn is when they start working. So what we're trying to do is put them in a position when they are competent and they are confident, uh, to start their own, their own trip. So we give them technical foundations. We expose them. To real life cases and projects with data, internships, dissertations that involve real data.

We try to get industry supervisors to their final theses so that, you know, we can actually have an experience of what is working in this renewable projects. We try to cover the four pillars of what we call the energy transition, which is make it profitable from the economic point of view, make it technically do-able, which is very important, obviously. Environmental sustainable, just from a social point of view.

[00:21:49] **Tamsin:** What about hands on experience? What can students get involved in that might be a little bit different?

[00:21:54] **Dr Alfonso Martinez-Felipe:** I'm actually highly involved with a team called Proto Tau. So it's a team of undergraduate and postgraduate students who are building a prototype car, a small car, just one person, but they do it from scratch and they using hydrogen fuel cells.

So what they do is they design the whole thing. They need to, you know, find the sponsors to fund their expenses, buy the materials. They got a lot of support from the University and the School of Engineering, but they also need to go out, sell themselves, start to make like a business case and, uh, you know, companies locally, uh, but also external companies like big companies are really happy to help because, you know, they sponsor something which is actually very good for energy transition so they actually end up, um, applying what they learn in the lectures in an actual project, and, and when you see the car over there competing, it's amazing because, you know, you, the students see that, you know, they, they've done really hard work and they end up, producing something which is real and it's helping the energy transition to take place in the environment to be better.

[00:23:07] **Tamsin:** And Aberdeen's done quite well in this competition in the past, I hear.

[00:23:10] **Dr Alfonso Martinez-Felipe:** Yeah, I'm really proud of the students because the first year we managed to.. They managed to, to build a car from scratch in record time. We competed in the Shell Eco Marathon in London 2019 and, and we won the first prize as the Best Newcomer.

If I'm not mistaken, it's the first Scottish university to actually have a hydrogen car run in the competition. Now we are indeed recruiting new students for a team. So, well, that's a message out there. If anyone wants to join us, you'll have the plus to, to be part of something bigger. And, um, so we are obviously looking forward to welcoming you to the team.

[00:23:49] **Tamsin:** So as well as tackling some serious societal issues and the issue of our sustainable future, you also have a bit of fun along the way.

[00:23:57] **Dr Alfonso Martinez-Felipe:** Yeah, we do. And I'll tell you something, this is really good for the, now I'm talking as a lecturer here, for the students' perspective. It's not only good for their CV, it's also very good as a formative aspect because they learn the value of working in a multidisciplinary team when they need to have a good planning of the different tasks and how they're going to deliver them in time, and they have a commitment with their sponsors. They need to do a lot of press media. They are linked in. They were invited by the European Commission to give a talk a few years ago on their, on their experience and exhibit the car. They bring the car to London, Glasgow, different conferences on, on the energy remit.

So it's fun, it's a lot of work, but it's really fun.

[00:24:50] **Tamsin:** Thank you to Dr. Alfonso Martinez-Felipe for talking to us about his work. and sharing some of the ways Aberdeen Uni is helping to drive the global energy transition.

[00:25:00] **Swathi:** If your curiosity has been sparked, come to one of our open days and see our historic campus. You can also download our digital prospectus at www.abdn.ac.uk.

[00:25:12] **Tamsin:** And to hear more from us, check out the rest of the podcast. Each episode discusses groundbreaking research from one of Aberdeen's academics.