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Introductory Jingle

Innovate UK KTN connecting for positive change.

Steff

Hi, everyone. Thanks for joining us. Welcome to episode six of the HydroGenerally Podcast Series brought to you by Innovate UK KTN. We do jump around a little bit with presenters on this podcast. So you might not be aware that I'm Steff Eldred. I'm part of the Clean Energy and Infrastructure Team here at Innovate UK KTN and lead on our Hydrogen Innovation Network. We've got a great guest for you today. I'm pleased to be assisted by my wonderful colleague Debra on today's topic. Before we dive in, just to bring you up to date a little bit. The HydroGenerally Podcast Series is the voice of the Hydrogen Innovation Network at Innovate UK KTN. We look at applications, opportunities and challenges of the hydrogen economy with a goal to help to enable local clean hydrogen uptake at scale, and comparable costs. And ideally, to help find some novel solutions to this really. If you haven't, then if you go to the Innovate UK KTN website through the link in the description, you can sign up there and then you'll get newsletters updates, anything that we're making our members aware of, also there you should find previous episodes of this podcast and an overview of the podcast series. So before now, we've learned all about hydrogen production, and where it should and could be used. That was right at the start. We then dived into some of the sectors. So far, we've talked about glass, aviation, and marine, I think that's it. Today, we've got something a little bit different. So we're going to discuss the role of Waste-to-X or Waste-to-Hydrogen in this new hydrogen economy world. I already mentioned that Debra is joining me today. So yeah, hi, Debra, save the listeners from my voice for a little bit. Tell them who you are, and a little bit about your role. And then don't forget to introduce today's guest.

Debra

Thanks, Steff, for the lovely introduction. So I'm Debra. I also work with Steff at KTN. I'm part of the Chemistry and Industrial Biotech Team. So just to add a slightly different slant on hydrogen from a chemistry point of view, hopefully. We are really grateful to welcome Rob Dent from BOC who's joining us today. Rob is well known to us at KTN. He has sat on a number of panels with us and also shared case studies at a number of events. As an Applications Engineer at BOC Rob is ideally placed to help us to understand how Waste-to-Hydrogen works and what the opportunities and challenges look like moving forwards. So, hi, Rob. Please could you introduce yourself and explain a little bit more about your role?

Rob

My name is Rob Dent, I'm the Application Sales Engineer for Chemistry, Energy and Construction in BOC. I'm part of a team of about 17 Applications Engineers working across different sectors. Over the last three years, we've been incredibly focused on industrial decarbonisation and hydrogen fuel switching. I guess a little bit about BOC, we're industry leaders in designing and implementing hydrogen mobility and industrial, decarbonisation solutions. We deliver real world projects, at a commercial scale across the UK, helping government and businesses to reduce their carbon footprint and drive net zero ambitions. We're the largest industrial gas producer and we've been safely handling hydrogen for over

100 years. So we see it as a core growth machine in our business. And you know, we would like to push that market forward and foster the use of hydrogen in the right places and the production of hydrogen from the right sources. I think that the belief within BOC Linde is that there's no silver bullet to decarbonisation. The industry has got several options to choose from, fuel switching carbon capture, electrification, and energy storage. But yeah, there is no silver bullet and we want to enable our customer base and sort of the wider ecosystem to get to a lower carbon sort of future.

Steff

Great, cheers. Thanks, Debra. And Thanks, Rob. Yeah, totally agree and echo what you just said really. I think, yeah, there is no silver bullet and at KTN suppose we're trying to work across all the different options or the options that are going to work together collaboratively to help move us to you know, 2050 net zero and what have you. Yeah, definitely more comfortable with two chemists or chemistry experts in the room. So thanks for both joining me today. It probably won't surprise you Rob, to say, let's start with a question. So, as you all know, from our previous discussions, and as our audience will find out throughout this, I'm very far from an expert on Waste-to-X or Waste-to-Hydrogen. So, could you just give our audience an overview of what we and what you mean by this?

Rob

Yeah, so there are two main routes to sort hydrogen or chemicals from waste, and that depends on the type of waste you're trying to process. So we've got really well established sort of biogenic processing means, you know, throughout aerobic digestion or you know, worst case scenario landfill that is produced by methane and then you can react that by methane with CO₂ to make either sort of SAF, or olefins or renewable dimethyl ether or then you could steam methane reform that by methane to it to a net zero carbon hydrogen. The sort of other avenue for this is the processing of municipal wastes. So, MSW or Municipal Solid Waste or RDF, which is Refuse Derived Fuel is inherently a mixture of non-biogenic and biogenic components with sort of inorganics in there as well and sort of aggregates. And that's really difficult to process because there's a variability of the waste, but effectively, you can gasify that material with a mixture of oxygen and steam, which then produces a crude sin gas and then you need to reform that sin gas to get to a pure sin gas mixture, which is hydrogen and carbon monoxide. You can then put that pure sin gas through honoured reactions, such as water gas shift or a PSA or Fischer-Tropsch to target a pool of molecules, such as synthetic gasoline, for example, or SAF or you can just purify into your hydrogen molecule, which can then go into transport. We support both sorts of avenues on both processes with critical oxygen nitrogen for the reactions that are taking place in the process.

Debra

Great, so that makes a lot more sense now. So we now understand how it works. Where are we up to with this in the UK? And, you know, potentially the rest of Europe and beyond? Are we set up and ready to go? Have we got enough facilities here already in the UK? Or are we being optimistic here, is it a few years away before we're going to be ready to deploy this on a larger scale?

Rob

So the HazWaste industry has been using gasification for sort of many, many years to effectively make HazWaste safe. But that's more with a focus on waste management and

power as a sundry sort of offtake from that. But the gasification of waste with a view to reducing molecules or fuel cell grade hydrogen is kind of on the cusp of industrial commercialization. So, there's a flagship project called the Fulcrum Biofuels Project in Nevada, which we're supporting with technology. That aims to take 175,000 tonnes of unsorted MSW per year and produce 11 million gallons of biochar per year which will then go into various pools of hydrocarbons, you know, with the focus on sustainable aviation fuel. I think that the success of that project is really critical to this industry. Every project that I talk to in this space, in the UK is looking in on the Fulcrum Project to be successful. So it's important that this kind of Cornerstone Project is successful for the rest of the industry. It is going to be a big factor in getting those projects to the final investment decision. So yeah, most of the UK projects at the moment, are sort of at a demonstration scale. But we've got larger projects that are kind of industrial scale and about to reach FID, which is really exciting.

Steff

So there are obviously challenges with all of the technologies we're trying to use to move towards decarbonisation. But are there one, two, or three sort of top challenges around Ways-to-X that you would highlight, that are well known? Or is it, like you said, is it a case of getting the finance and the commercialization sorted? I just wondered what your thoughts were on that.

Rob

So, you know, with all hydrogen projects, or any kind of fuel production project, offtake agreements are kind of critical to that, to that investment decision being made, without a business case, there's no project. So that's kind of number one. And I think that, and you'll know Steff, that goes across all hydrogen projects, the classic chicken and egg situation. I think we need BEIS to provide infrastructure around the sequestering of CO₂ from these plants so that the hydrogen can hit the low carbon hydrogen standard and achieve those subsidies. You know, and if you want to get these projects going now, then, I'd go as far as to say that this type of technology needs an exemption from BEIS until the infrastructure is there to get them to sequester the CO₂ that comes off that plant. Obtaining a long term waste contract for the volumes of waste that you'd need to make the volumes of hydrogen that you want, is difficult in the UK, especially in certain regions. That's why I think that sort of exploiting the Freeport status of Teeside for example, to generate an export market for waste hydrogen would be interesting. You could, for example, import waste, convert at Teeside and export tax free, which would potentially offer an advantage in the market. Then I guess that the major technical challenge is producing a consistent SYN gas from variable waste foods. So you need an incredibly experienced team, you need competent engineers, and a team of experienced engineers that are commissioning the plan. Where these types of projects tend to fall over, is in the underestimation of the cost of commission. So commissioning this sort of plant could be anywhere between 20% and 80%, of the capex of the entire plant. And that is something that can kill a project if it isn't budgeted for. So, you know, and underpinning that we need a long term funding model for paying for the hydrogen.

Steff

No, that makes sense. Yeah, just a comment really on the, you know, chicken and egg situation that comes up time and time again. And we get approached, and I know from our conversations that you get approached from a lot of end users saying, you know, where can

we buy, clean green hydrogen, you know, for X project, X demo, whatever it might be. I suppose just the comment and the feedback to those end users that might be listening would be, even if it's not available for your project, or on the scale that you need, make sure that the producers or these projects are aware of your need, so that it can get built into those investment cases. So that those can go ahead, you know, and we can move forwards on it I guess.

Rob

Yeah, absolutely. I think that that's something that BEIS are trying to address with their funding rounds now in that, you know, for these demonstration projects that require hydrogen, realistically, you're not going to get your hands on substantial amounts of green hydrogen at the moment, but you do need to prove the concept. And ultimately we need to know as BOC where the demand is coming from, so that we can so it can service that market as it grows.

Steff

Yeah, absolutely right, yeah. And then, obviously, we don't know when people will be listening to this. But yeah, I guess the main things we're referring to are the Net Zero Hydrogen Fund and hydrogen business model strands three and four that will come later in the year.

Debra

So Rob, how is the waste sector set up for this? So are there any issues around supply? Because I know in my local authority, our municipal solid waste goes to an energy recovery facility. I've actually had a tour of it. It just gets burned basically and the steam that comes off it is power to go back into the grid. But presumably, that was set up with some sort of supply agreement with a local authority to take the waste. So is there likely to be competition between these Waste-to-X technologies? Is there any issues around getting enough waste to do this Waste-to-Hydrogen?

Rob

Yeah, I mean, there certainly will be, I think. I mean, generally, these large incinerators are our long term waste contracts and are paid out on something called ROCs. So ROC Renewable Obligation Certificates and they run for sort of 10/15 years at a time. Now, I think that the waste sector is a massive change coming, you know, as the Emissions Trading Scheme starts to become something that the waste sector has to think about, as exemptions start to fade away. Incinerators are great to get rid of a load of waste, but actually, they're not that environmentally friendly and they're processing 300,000 tonnes per annum, per facility. So as waste starts to become more of a tradable commodity, I guess, in terms of, you know, gate fees coming down, potentially things like RDF starting to attract either flat fees, or you're starting to have to pay for RDF. Then you need to think that the waste sector is going to have to think about new ways of getting bang for their buck, you know. Can they realistically retrofit CO2 capture to an incinerator? Yes, of course it can. How many of the large scale incinerators are based in the clusters where we're going to have that infrastructure? I don't have any figures on that. But you see a lot driving around the country that are certainly not. I mean, the issue with solvent based capture of CO2 from an incinerator is the flue gas stream. So there's a lot of potentially heavy metals, high NOx, high SOx and not very high concentration of CO2. So it makes it quite difficult to capture at a high

efficiency, but also the solvent has got to be replaced more often and that, you know, potentially makes these incinerators as their subsidy mechanisms die off, you know, unfeasible. So, well, firstly, you know, is the grid greening up compatible with incineration moving forward? I don't really think so. Is burning our way something that the public wants to see? I don't think so either. So, I think that we should be looking at other technologies and the market is looking at other technologies. But like I said, there's a kind of perception and reliability hurdle that we need to get over to ensure that this kind of change in the market can be a success to a cleaner, greener one.

Steff

Cool, cheers. Thanks for that, Rob. Very comprehensive. We've probably only got time for a couple more quick questions. I've got a view on this as well, so cost, obviously the elephant in the room really, but how does Waste-to-X compare with other options like electrolysis, or conventional natural gas? And as I say, just a real quick viewpoint on that. I suppose, my thought would just be that for the quantities of hydrogen we are going to need, for what's been stated in the Hydrogen Strategy and various other documents, you know, the Committee on Climate Change, for example, we need all of these so I suppose there's an element of it, yeah, we need them all. But yeah, I just wondered where it fitted in terms of costs.

Rob

So I'm not gonna give you any figures because, you know, it's kind of difficult because it's built up of multiple things, but it'll be somewhere in between unabated SMR and electrolysis hydrogen. There are four main factors to your costs. So you've got a gate fee, you know, how much gate fee you're getting per tonne of waste that you're processing. What is your cost of oxygen? Because oxygen is a major capex in your processing. What was the capex at the plant? And what purity of hydrogen do you require? I think that this type of hydrogen fits really well for industrial fuel switching or rhetoric diesel replacement schemes like internal combustion. Because you don't need to worry too much about the purity of the molecule for those types of things. And these types of systems integrate really well with electrolyzers being able to take off the sort of wet, low pressure oxygen and feeding that into the gasification. So you then have a fuel cell grade hydrogen coming off your electrolyzer and a cheap, clean hydrogen, industrial hygiene coming off your gasification process. I just think that's a really nice kind of fit. And, you know, that's something that we as ITM Linde Electrolysis are looking at to provide the market.

Debra

I'm really conscious that while we're here, we focus mainly on waste. But seeing as we have Rob Dent from BOC with us, it'd be really rude not to ask about the industrial gas sector and how BOC are pushing the hydrogen agenda just now?

Rob

Yeah, thanks very much, Debra. BOC Linde, as you may or may not know, have been involved in producing and supplying hydrogen for the industry for over 100 years. We operate the world's first high purity hydrogen storage cabin, plus pipeline networks totaling approximately 1000 kilometres globally to reliably supply our customers. We're at the forefront of the clean hydrogen transition, and we've installed two hundred refuelling stations and eighty electrolyzers across the world. We have key alliances with people like ITM to

provide world beating, green gas solutions with the world's largest PEM electrolyzer in Leuna feeding into our chemical complex. And we're involved at the highest level in government support for the emerging hydrogen economy, trying to lobby for the right type of legislation to meet hydrogen work in the right sectors. It's not applicable for every sector, so we need to make sure it's being used where there's the biggest sort of environmental gain. We're currently embarking on a kind of campaign to decarbonize our hydrogen, our hydrogen sort of system, our hydrogen production system with our first capture plant for Teeside. Then as these major cluster projects emerge, we will be providing, sort of that critical oxygen for the ATRs, critical nitrogen for safety and ultimately kind of helping with the distribution, I guess, and we will deploy the correct assets in the clusters to support that infrastructure development.

Steff

Great. Cheers, Rob. Yeah. I think what you were just saying about where hydrogen can offer the most benefit to decarbonisation. I mean, that's exactly what we're, I think it was episode two where we have Joanna from Ricardo talking about exactly that. So yeah, we're big believers in, there's not one solution to decarbonisation, we need to find the right solutions for the right applications and where they can bring the biggest bang for their buck. So yeah, can't believe the time again, as seems to happen with every episode. It's flown by, so yeah, just need to start wrapping up. So thanks so much, Rob. I really enjoyed talking this through with you today. And I know our listeners will feel the same. I know you're on quite a journey at BOC so you know, obviously keep in touch and keep us up to date with progress being made.

Rob

Absolutely. Thank you very much.

Debra

Well, thank you very much for listening. Any links that we've mentioned today, and also a direct link to the Innovate UK KTN website have been added to the description. As Steff mentioned earlier, don't forget if you're not already signed up, sign up to receive our newsletters and updates. In the next episode, we're hoping to discuss hydrogen for heat and Steff will be joined by Jenni McDonnell MBE for that one. Thanks again for following us and goodbye.

Outro Jingle

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