



## Energy Talks

### Exploring the hydrogen opportunity with Jon Carpenter and Alex Haynes

Darren Hill (00:05):

Welcome to Energy Talks. The podcast will retake you behind the scenes and talk to the people powering the energy sector. This week I'm joined by Alex Hayes and Jon Carpenter, where we're gonna be talking all about hydrogen. What's the biggest topic going to be in 2023? And will it disrupt the energy landscape? So sit back, grab a cup of tea, coffee, and enjoy this conversation. Alex, John, thank you so much for joining me here today. And today we're gonna be talking a bit about hydrogen.

Jonathan Carpenter (00:31):

Awesome. Great to be here. Thanks very much.

Alex Haynes (00:32):

Thanks, Darren.

Darren Hill (00:34):

Yeah, thanks for joining us. So I'm going to start with the big question first. So it's been a lot about, we've talked about colours and that, but I feel like that's over now. So what do you think's gonna be the biggest topic in hydrogen in 2023?

Jonathan Carpenter (00:45):

I think I, I, I can start by saying getting some projects actually into delivery. It's almost been a bit of a, a kind of phony war for the last couple of years. There's been lots of talk, lots of mou lots of bits of kind of engineering and concept work. We've been doing a lot of kind of concept pre-feed, feed engineering, but the, the projects haven't actually got into that delivery phase. So I think the the topic or conversation this year will be very much, how do we get these projects really moving, get them through f i d, start putting some concrete and steel in the ground, and then the challenges that all of that will start to uncover when we start building these things out for the first time. Yeah, I completely agree. I mean, it has to, we have to start building these things.

Alex Haynes (01:24):

It's too much talk. It's the fuel of the future. There was a, John and I always laughed, there was a joke at Cop 27 in Egypt, where, where someone said, said to the interview, I'm sorry, I couldn't hear your question, but I know the answer is hydrogen <laugh>. And, and it, and I think that sums up the last couple of years. Quite a lot. There's so many blog posts and, and MOU and discussions, but no one's actually producing anything yet. Yeah. And we need, if, if we're gonna get to net zero and hydrogen is one of those energy vectors that we think is useful, then somebody's gonna have to start producing it in a low carbon or zero carbon way and actually



have people use it. And, and hopefully we're on the forefront of that in some of our projects here in the UK and, and globally.

Darren Hill (02:06):

So what do you think is gonna make, what's gonna turn the tide? What's it gonna people say, right, we've, we've done the talk and what's gonna make them tip the balance note to actually get into delivery?

Jonathan Carpenter (02:15):

So I, I'll, I'll talk about the, so there's, there's one bit which is really helpful, and then I think Alex will pick up the button on, on some of the kind of financing side. So governments have a really key role to play in the energy transition in general. So the technologies that we're looking at are new. We haven't done this before, and particularly we haven't done this at the scale that we need to do it. We need to change the whole kind of energy infrastructure of the planet in about 30 years to have any chance of getting us to net zero. So governments have got a really important role to play in kind of catalyzing that. So, you know, particularly developed western kind of governments, putting down funding, putting down incentive mechanisms or taxes kind of disincentives to get this thing moving. So in the UK and Europe and America at the moment you know, we are seeing schemes come into play, the, the Inflation Reduction Act in, in the states, the new green deal that just came out a couple of days ago in, in Europe that will start to put funding into these projects, make these projects kind of economic and, and provide that kind of underpinning so that they can actually start to get this away.

(03:16):

So I think that that's one, one really big thing we need to see to, to get this going. And once, once you start getting some volume into the market and there's more kind of understanding of how it works, then there'll be more comfort. and then other projects that maybe don't have that in some other markets will hopefully be able to get away as well. But then the other problem is, is, you know, what do you pay for this stuff? Yeah, yeah. That, that so the government regulation helps, right? Because that can often with grant on subsidies that can often help set that price, but we're seeing small, smaller projects, maybe not the big export projects, also struggling in understanding what their long term offtake price should be. Yeah. So if you are setting up a project here in the UK and you want an offtake for 15 or 20 years, what price do you pay for that hydrogen in 2035?

Alex Haynes (04:04):

Yeah. What, what's the market rate? And because it's a new energy vector, it's, it's not, it's not easy to estimate. And we've had clients who've gone out to two different professional services that will estimate the price and come up with two different answers. Yep. So how can you then negotiate your, your long-term agreement with your offtaker if there is an agreement on what that value is? And there's so many unknowns on, on the actual cost of gas, the cost of energy, whether there's a premium for it being green or if it's a different color or what, what level of carbon it's got in it depending on taxes. So it's proving very challenging. Where, where we're seeing these projects go quickly is when it's displacing an internal fuel source. So where you



are using fossil fuels, there's a and you want to displace that directly with, with green hydrogen or low carbon hydrogen. then, then you can make that decision. If it's relatively small scale as a business, depending on your ESG goals, your shareholder value, maybe your first mover in the market as a premium, because you're selling a green product as opposed to a, a gray product. And, and I think that's where we'll see those first moves go quickly where they can control that long-term pricing internally.

Darren Hill (05:19):

What do you think are the main challenges associated with the widespread adoption as hydrogen, as an energy source? What's can Petrofac do? What can industry do in what's, what's really holding us back?

Alex Haynes (05:29):

Hydrogen is not a, a silver bullet, right? It's one of a number of, of, of routes, whether you use it for transport and there's lots of debate about that. Yep. Right? It's, it's, it's going to be, we're heading towards a fragmented energy system, right? So we've been spoiled, right? We've had this, this one, one solution fits everything. Isn't it wonderful? And it has been, you know, a great driver of economic prosperity. However, the, the back, the backstory is it's also driven climate change. Yeah. So, so how, how do we keep that energy priced down? How do we keep it accessible for everyone? There's still billions of people on the planet who, who don't have access to, to any kind of energy, you know, heat and light for their home. So they can study, their kids can study at night or they can heat their food.

(06:14):

So how do we, how do we, I see a future where there's many different routes for low carbon energy and a little bit like the cell phone revolution where, where part large parts of Africa didn't get phones because the copper lines to go across that small village that that inland piece was wasn't worth the, the cost. And then suddenly everyone had a cell phone and it was relatively easy to get access to phones that all got, you know, three or four these days, right? Everyone has more than one. So <laugh>, yeah, I think you can find a this fragmented bespoke and, and it's, it's it's horses for courses or, or you, you find a energy solution that works. So if, if you've got access to geothermal resource where you can produce energy that way, then that might be the cheapest thing for you.

(07:01):

It might be solar, it might be solar plus a battery, it might be solar plus wind. And I think, and then in some industrial areas it might be ammonia, largescale ammonia import or, or large scale wind import. And I think we've gotta get out of this, this habit of, of looking for the one solution. And, and actually the great thing is there's so many solutions now and there's more coming all the time that can be almost bespoke to that area that can then be used globally. So I think you're gonna see a wider range of different energy sources from a more fragmented, rather than a, a central hub and spoke model. You'll have have this sort of cellular model. and, and frankly I think that's gonna give us more resilience because you can have multiple backups and multiple forms of energy coming into you actually I think is a really good part of the mix.



(07:54):

But it's not the only part. Yeah. And, and I think we need to be cognisant of that.

Jonathan Carpenter (07:57):

And just going back to, you know, where, where does it make the most sense to, to use hydrogen? Where is displaced the hydrogen? It's already that there's already kind of a million tons a year of, of hydrogen used in, in refining, in petrochemical, in kind of hydro treating hydroprocessing in fertilizer. That's probably the other kind of major use today. So if, if we can just decarbonize all of that, that's probably one, one and a half, 2% of global emissions straight away. And it's, it's displacing exactly the same molecule. It's just a lower carbon version of it. which is just the fundamentally the best thing to do. most of the other applications do need some upgrades, whether it's a drive train in a truck or a train or, or a boiler tip in your boiler at home.

(08:36):

you know, there, there needs to be some kind of upgrading to, to make use of the hydrogen. but just on, I explain one of the other drivers we're starting to see is also around energy security. That resilience that hydrogen can give you as an alternative fuel source, particularly with everything that's kind of happened in the Ukraine. You know, we're, we're starting to see clients really waking up and, and this is obviously a big driver for Germany, for example, you know, how can they get energy from another source? And, you know, hydrogen, particularly if you can transport it around as ammonia or methanol allows you to bring in electrons effectively from places in the world where they've got lots of great renewable resource. and then transport those electrons in the form of hydrogen or its derivatives over to Europe where, where they're fundamentally short of energy.

(09:19):

and, you know, that's gonna be, I think a big, big, big driver kind of going forward. It's not just the, the decarbonization, which is, you know, fundamentally required as well. But, you know, energy security is becoming a much bigger driver of this too.

Alex Haynes (09:31):

You're seeing, you're seeing this huge build out of wind in Europe, certainly in the uk and, and you've got Scot Wind and all the rest of it. And, and actually far more wind energy can be produced, probably will be produced because you're gonna have to have over capacity for the days that aren't windy. Right. See, if, if it really is a windy day everywhere, then the UK grid's gonna fall over quite quickly and we'll have excess electrons. So, and the same in Europe. So, so if, if you can get everything electrified that makes sense to be electrified close by, then that's the most efficient way of doing it.

(10:04):

And you're not, you're not paying the energy penalty of, of changing into a, a molecule. But then there will be certainly days, and I forget the numbers for, for telman in the UK alone last year,



but it was, it was, you know, billions or trillions worth of billions and pounds worth of telman where they just shot the energy into the ground, right? Cause we couldn't use it in the grid. Well, if you've made that investment and you can quite simply use that excess electricity and store it as hydrogen, then that makes a lot of sense. And then if you can use that hydrogen locally to where you're making it so you avoid the energy penalty of transportation, that also makes a lot of sense. So it's, it's gonna be iterative process, but Yeah. But you know, as John, as John said, you know, economic drivers and greed will, will push us forward.

(10:51):

And where, where there's an opportunity, oh, I've got this asset or these electrons that at the moment I'm doing nothing with, what could I use it for? Yep. And then suddenly you start to produce hydrogen locally, and then it goes to the local bus service or local you know, garbage trucks, whatever it might be, or the taxi firms, then, then you can suddenly make a buck or two on it. That makes a lot of sense. And I think you're gonna get, as I said before, this fragmented approach where, where you get this sort of energy resilience and layering of different different sources, which you getting is, is good news, right? He should, he should honestly make it cheaper. Yeah. For, for, for all.

Darren Hill (11:29):

We've really moved on on wind and Petrofac's been part of that for over a decade now. So it's, it's nice to hear that, like you see these two coming together. It's not just, oh, we've missed the boat because we've gone electric. But these hydrogen actually can almost act as a glue around it to cover all the gaps as well.

Jonathan Carpenter (11:46):

Cheapest forms of power anywhere in the world today. some of the solar plants in, in Saudi and the UAE, they're, they're talking about, I'll, I'll do in pencil sense, but it, it is kind of 1.30 cents a kilowatt hour. you know, it, that's, that's a phenomenally low price. Mm-hmm. <affirmative>. So, you know, the more of that you, you can build out that starts to unlock, you know, really interesting things. Challenge, of course is the sun's only on during the day and the wind blows when the bit wind kind of feels like blowing. but this is one of the advantages for hydrogen. You can turn, you know, when you've got too much wind or sun or you know, you, you kind of overbuild. So you can build a bit of extra capacity. You can turn those electrons into hydrogen. You can store that for longer periods of time, much better than a battery.

(12:28):

and then either use that hydrogen, which Alex was saying, it's the best thing to do with it, but if you need to, you can turn it back into electrons when the wind or the sun when the wind's not blowing or the sun's not shining at the end of the day. so it, it's gonna be a mix and I said oil and gas is gonna be a part of that future. We need to decarbonize that as well. So whether that's, you know, carbon capture kind of on the back of, of those facilities so we can capture some of the emissions. but yeah, there's a, there's a huge amount of of work to do there. And you know, hydrogen's gonna be very much right in the middle of all of that.



Darren Hill (13:00):

Yeah. It seems like it's the opportunities there, it's just how do we, yeah. How do we capitalise on that? And so what's the, we've mentioned at all, so what's, what's the main opportunities at scale for hydrogen? How, how far does it go? I know we've said it's, it's a supportive one. How far can it go as an energy source?

Jonathan Carpenter (13:18):

It, it's a, it's a really good question. And, and yeah, to a degree it kind of, it depends on the different applications you see for it. you know, when you look at the research, it said the energy transition is gonna have lots of different solutions. It's not just hydrogen or just carbon capture, you know, there's gonna be all of the above plus biofuels, plus electrification. so it's kind of where does it play in, in the mix? And, and it's back to, you know, where's, where's the hydrogen? The kind of most optimal solutions. So he said displacing. Yeah, gray hydrogen in refining petrochemicals kind of fertilizer is the obvious place to start. you know, in some of those hard to abate sectors, we can see it as a, as a really good use case. so things like shipping you know, today ships are, are burning fuel oil, you know, some of the more modern ones are kind of burning L n G, but there's fundamentally an emission associated with all of those.

(14:08):

You know, one of the, the use cases for those, you know, excess electrons we're seeing in, in very windy, very sunny places. So kind of Western Australia, Chile, Namibia, Iman is actually converting that hydrogen into ammonia or methanol and then, you know, burning that ammonia or methanol in, in the ships. and then using those ships to move the ammonia and methanol around so that that kind of hydrogen, those electrons are able to be moved across the world. Again, shipping is two, two and a half percent of global emissions. so that's, that's a very material sector and one that, you know, you need a, a zero carbon, a zero carbon fuel to be able to, to mitigate that at some way. And certainly ammonium is, can be a zero carbon fuel. and as someone was pointing out last week, particularly ammonia, it, it's almost infinite in how much we can produce.

(14:57):

There's, you know, 79% nitrogen in the air. and there's, you know, we've got loads and loads of water on the planet, fortunately and there's a lot of sun and, and winds and, and geothermal that we can go after. so you put those, the combination of those things together and you've kind of got an unlimited supply of ammonia. and again, ammonia we can use as a, as a fuel in engines. you can actually burn it in power stations as well to create electricity. so there's lots of, other than as ammonia in the fertilizer industry, there's lots of other good things you can do with it too. It's a bit different to handle, but you know, there's you know, we understand that it's not like it's a completely new, new molecule. and those, those projects to get the economies of scale and those, you know, we were talking about, you know, the cheapest solar, but you know, those solar fields are, are kind of one and a half, two gigawatts a pop.

(15:45):



That's a really big Yeah. solar field, we're talking about thousands of, of square kilometers for some of these projects. You know, we we're doing gigawatt scale projects in offshore winds. Now we're seeing multi gigawatt scale projects coming around Europe. and then, you know, if you wanna convert all of those electrons produced into hydrogen, you know, we're talking about multi-billion, you know, dollar projects. At the end of the day, you know, these, these are as big, if not bigger than some of the biggest things we've done in oil and gas, but actually with no less complexity it's just, it's, it's a slightly different makeup of the complexity. Half the project is, is renewables. It's producing electrons from the solar in the wind and then half the, the, the other half of the project is turning those electrons into some molecules and then kind of doing something with whether they're shipping or whether that's putting them into some other process at the end of the day.

(16:33):

so yeah, the, the potential is as a market is huge and, and suddenly a potential per track is, is really big as well. And something we can see a really good use of all of our skills and experience to kind of play into almost immediately.

Alex Haynes (16:45):

We're seeing, we're seeing hydrogen as a feedstock into SAP as well. Yeah. So sustainable aviation fields and again, if you can't use the hydrogen locally, then if you can combine it with some cot, which there is plenty of either bionic or we're seeing it from cement plants or other emitters, and they can start, you can start to produce these eels. So whether it's ethmol or, or, or, or SAAF. So again, a bit like replacing the grey hydrogen refinery, you can replace it in a, in a, in a new process and, and there's a huge demand for saaf a hydrogen plates.

(17:19):

Yes, I'm sure they can work at some point, but there's a lot of debate about that. But if you can use that hydrogen and mix it with CO2 and other to create the aviation fuel, well we exactly know exactly how to use that. Cause it's a, it's, it's a drop in fuel, it's a complete replacement. You can price it. it's much easier. And there's huge demand on the airlines as they try to decarbonize everyone's going on holiday in the year or business trips, whatever it might be. So I think there's a, there's value to it there as well. And that's why I think that that hydrogen question, where is it being used? It's going to be, it's going to sort of sort itself out because, cause the, cause the highest value use for it is where it will go.

Darren Hill (17:57):

What makes Petrofac a good fit to drive these initiatives?

Jonathan Carpenter (18:02):

We've been dealing with hydrogen molecules in refineries for well over a decade now. We've been separating CO2 from natural gas streams for, you know, probably three decades or so, particularly in the Middle East. so we understand, you know, both of those molecules. and then as you said in the last kind of 10, 15 years you know, we got into the offshore wind space, so



actually we really understand the electron side and the transmission of electrons and the transformers and the, the system designed that. so when we, we looked at it, we're like, well actually we've got, you know, all all of the, the engineering understanding actually a lot of the technical and project delivery skills and some of the operations and maintenance skills that kind of go with all of that already. The other thing that we bring that I think is being particularly valued by the, the customers in this space is our ability to take a project from its earliest kind of concept phase and kind of the sketch of, you know, I'd like to make some eels and I've got a bit of CO2 over here, and I, I think I've got some sunshine and some wind.

(18:57):

and be able to take that from concept into the kind of front end engineering design, and then be able to say, well, we can, we can build it for you as well. Actually, we're thinking about how we build it when we are designing it, and actually not just that we can operate it for you. And again, a lot of these developers, customers, maybe they're coming from a utilities or renewable space, or maybe they're a, a cement business or an engine from waste business and they've never had to run a hydrogen plant or a carbon capture, a chemicals plant ultimately at the end, end of the day. and so there's a lot of new challenges with that.

Darren Hill (19:25):

So do you think that this is, that hydrogen has a potential to disrupt the energies, the world's energy landscape?

Alex Haynes (19:33):

This, this energy transition is gonna disrupt an awful lot of things that maybe we're not quite sure. You know, we haven't seen that impact yet. We don't understand what that impact will be, but it's gonna be a fascinating time to be around Yeah. As, as the globe sort of remakes itself in under, under these new, this new energy map.

Jonathan Carpenter (19:51):

Yeah. I mean, it, it's a kind of democratization, decentralization of, of that energy system. We're already seeing some of those traditional energy players. who've kind of realised how this is evolving. So the Saudis, the UAEs of the world you are judge, their place in the world is as an energy exporter today. and they've kind of quickly realized, well actually we've got a load of sunshine and in some places a little bit of wind as well. So, you know, we can maintain our position in the world by leverage.

(20:18):

They, they're lucky. They've got, you know, supply chains, resource base an understanding of how to do these big energy projects. And so they're moving very quickly to try and get their position and, and ultimately maintain their position in the kind of geopolitical pecking order of the world by kind of maintaining that, that energy export capability. But yeah, we're, we're seeing countries, you know, coming up in the world, you know, the UK who has, you know, dropped off really as a, a kind of hydrocarbon producer, you know, suddenly with the Saudi Arabia of wind





you know, 25 gigawatts in one round in in Scotland you know, there's, you know, 2, 3, 4 times that potential easily mm-hmm. <affirmative>. So, you know, what are we gonna do potentially with all the, those electrons? Suddenly we're, we're in a, a much more interestingly kind of geopolitical position potentially is an n GX exporter again. which, you know, we've not had that kind of position since, you know, probably the early mid seventies, I imagine, if we don't have to import energy ourselves again. Right. So that has an impact on the government's finances, right? Yeah, very much so.

Darren Hill (21:17):

My final question you mentioned mobile phones earlier on, and I think, I think my, but I'll, I'll do it in two tranches here. So my era was the Nokia 3310 that changed the game technologically, and then for younger listeners the iPhone changed the game. Again, <laugh>, just so we can get both and out outing myself my age by saying Nokia 3310, but, so there's that moment in history where technology changes the game. Is there anything like that on the horizon you see in hydrogen that's going to drastically change the market within the next 18-24 months?

Jonathan Carpenter (21:54):

In the 18-24 month window? I, I don't think there's anything that's gonna be, you know, completely game changing. Mm-hmm. <affirmative> really, it, it's gonna be u understanding, you know, how do these projects become real? and then, you know, the game changer will be, be actually kind of seeing them come to reality. So the firming up of the commercial models, the financing models, so it, it goes from, you know, bits of paper to actually, you know, proper projects, steel, concrete in the ground that's actually producing electrons or, or molecules. and, and to a degree that that will be game changing. you know, people will, will start to think very differently once they, they see this become a reality and they can go and kind of touch it and feel it, and then you get kind of comfortable with it. So actually it's, it's, it's not so difficult to produce or move ammonia around or methanol.

(22:41):

you know, actually there, there were suddenly these, you know, hydrogen fueling stations popping up all over the place. and, you know, actually I can get really good range of performance on a hydrogen HGV actually, maybe I should, I should switch my fleet over. And I, I think that that kind of, the realisation of this, it kind of becoming a reality will start to change attitudes and, and ultimately then kind of change behaviors. So I think in the short term, that's probably the biggest kind of impact I see. That, you know, it'll become real and suddenly people will really get behind it.

Alex Haynes (23:13):

I think, I think again, because it's an unlimited resource, solar and wind. Yeah. And, and you look at these different suppliers, it's much more competitive. And I, I truly believe the cost will come down. Yeah. Mm-hmm.



(23:24):

<affirmative>, and then you start to look at the cost of energy's been a traditional constraint in growth across the globe in every industry, right? So imagine if you've got really cheap in some, some cases, maybe free or close to free electrons nearby, you know, a substation, you know, they've got these things, they turn into hydrogen and they're gonna sell it to you cheap, because otherwise it's given away or, or curtailed. So what, what could you do? What, what manufacturing, what, what industry could you build up nearby? Those, those, those areas? And it may be, it might be somewhere near like Liberia or Namibia or, or Omar or somewhere where if you think about the petrochemical industry, now often in Saudi or places you'll have fairly cheap access to gas locally. And then they'll form a petrochemical plant next to it because they can get access to it cheaply.

(24:12):

And then they start to produce high value products, which they can then sell. So it might be plastic bottles or fertilizers or, or fabrics. Imagine that now with electrons or hydrogen. Yeah. What industry, what growth opportunities are we gonna see across the globe in new locations where, where their energy is is really cheap. And that, I don't think that's gonna come yet. You're right. I think there's, we're right the start of this change go fast forward sort of 20 years, 25 years. I think fundamentally some areas of economic growth and this you democratisation of energy Yeah. In a cheaper way should have, you know, huge growth potential for, for the, for the human rights across, across loads of ways. And we're doing it we'll be doing it in a low carbon manner or a zero carbon matter.

Darren Hill (24:56):

Yeah. Listening to you both speak today. It's been it is, it is actually made me quite excited and I think the main word I'm gonna take away from it is opportunity. Thank you so much for spending the time with me today.

Alex Haynes (25:05):

Thank you Darren.

Jonathan Carpenter (25:05):

Thanks Darren.

Darren Hill (25:06):

Thank you. Thank you for sticking around to the end. I really hope you enjoyed the conversation between myself, Alex, and John today. If you wanna find out more about our new energy services, please head over to the website [petrofac.com](http://petrofac.com) and check out our other episodes that we have available too.