EDINBURGH SCIENCE

Will technology save us?

An Edinburgh Science Climate Co-Lab

Event notes

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About the Edinburgh Science Climate Co-Lab Series

The *Climate Co-Lab* is a series of round table events which bring together senior leaders and decision from across all sectors to tackle difficult questions relating to the climate emergency. These events spark collaboration, unlock potential solutions and drive change.

We began delivering these events in April 2019 after awarding the prestigious Edinburgh Medal to Christiana Figueres – the acclaimed Costa Rican Diplomat, instrumental in bringing about the Paris Climate Agreement. On her visit to Edinburgh, we organised a round table with leaders of business, public sector, third sector and higher education present. We were challenged by Christiana to collaborate, to act, to not wait for anyone to give them permission and to use the opportunity that presented itself for positive change. It is this optimistic ethos that has driven these events ever since.

Notes from all previous *Climate Co-Lab* events can be found at edinburghscience.co.uk/co-labs/

Heather Bell – Introduction

US Embassy, Department of Energy Attache in London

Good afternoon. Thank you so much for coming today.

Our topic today is Will Technology Save Us? And when I think about these terms, I realise that this question implies the question of – or the statement – we can't save ourselves and is that true?

I think about how economists have had to start using nudge theory to even get us to save for our own retirement. You no longer opt in you have to opt out, just in order to get people to save 1% for our retirement. Maybe we cannot save ourselves?

Human nature is such that we take the path of least resistance, how can technology create that path of least resistance?

It's a very important question and I'm excited to be coordinating this event with three experts who really have a lot to say and with all of you in this room who are going to contribute so much.

I work for the US Department of Energy, we are one part of the wider government and in the last few years, we have had a lot to do – and a lot to say – about our climate goals.

I think everybody knows about the Inflation Reduction Act (IRA). That was part and parcel of our Bipartisan Infrastructure Law. These are huge pots of money meant to achieve our climate goals but it's also meant to take the Department of Energy and our 17 national laboratories from a research and development organization and technical agency into a deployment agency.

We are spending an enormous amount of money, but we've also had to restructure how we approach things at the Department of Energy.

We have a new, Office of Technology Transitions, which makes links between Universities, National Labs, Incubators and Start-ups.

We have our Office of Clean Energy Demonstrations, which works with technologies to show proof-of-concept, specifically in areas that are focused on just energy transition and that may have been left out of previous energy transitions, ensuring that everyone is benefiting from our new carbon-friendly approach to things.

Finally, we are a technical agency, we also look at how we measure things. Our Office of Fossil Energy and Carbon Management is looking at our measurement mitigation reporting verification scheme and the UK as part of that along with the EU.

When we're going to do carbon taxes or when we're going to make decisions on how we spend our money based on emissions of methane, carbon etc., how are we measuring it? What metrics do we use? What counts and what doesn't? And that's one way we can bring everyone to the table in a voluntary scheme.

I very much enjoy the flow of the discussions that we will participate in today, where we go from developing and financing the technology to then deploying the technology and having it accepted by the public.

I'm really glad you're all here and I hope you will all feel very welcome and open to contribute. This is a perfect sized group and all of you are here because of who you are. You are the right person to be here.

Our first speaker is Richard Nimmons, CEO and Co-Founder of Carbon Capture Scotland, a mechanical engineer who can really speak to the how we how we develop these technologies. I will say, carbon capture is a very important part of meeting our net zero goals. And I will leave it to him to give us more on that.

Thank you very much.

Richard Nimmons

Carbon Capture Scotland, CEO & Co-Founder

I'm Richard Nimmons, co-founder of Carbon Capture Scotland, with my brother Ed, who can't be here.

We've got a good combination, although I'm very more mechanically minded than my brother is, I'm quite dyslexic. So, I learned all this stuff from working offshore in the oil and gas industry. I had a much harsher, 18–20 year-old part of my life than my brother did at Cambridge University – where, smart as he is – he managed to get two firsts.

We wanted to start this business up to effectively remove CO2 from atmosphere and, working offshore, hitting something with a hammer the answer suddenly sprung on me. I didn't hit my head in the hammer – I just I was doing something else at the time.

I realised that I really want to put the CO2 into the wells which were taking all these hydrocarbons out.

The only thing I knew about CO2 was you can use it, for blasting rust and paint off things, so we, we started business up doing that. In time we had mobile dry ice production kits in seven continents, in the oil and gas space.

We were bought out with a high seven-figure sum by a gas company in 2019.

So then, with all this cash, what do we do? We didn't buy Ferraris or cool things like that (although we bought some clothes). We ended up buying some carbon capture kit. Our wives weren't all that chuffed with that at the time, especially as the kit that we bought was part paid for, we hadn't raised the rest of the debt and we didn't have the agreement signed with the biogas plant that we were going to stick it onto. We didn't have the power purchase agreement. We didn't have the land lease. We didn't have the customers.

But, if you if you stick yourself in that situation; it's amazing what you can, what you can achieve.

We managed to get all those contracts signed off just in time for the CO2 crisis that came about and we were, at one point, the only CO2, supplier in the UK. With the Pfizer vaccine coming out, we managed to make all the UK dry ice supply for that wholesale snip on gas. That allowed us to get a big contract which allowed us to get a large foreign debt, global equity, to build our own CO2 recovery – or carbon capture system.

We basically designed a system – and this is how not to do it – it was way too long and cost way too much. We knew if we were going to scale it up we had to do something different. So, we managed to put a whole new system together within a 40ft frame – we're now able to scale up and have multiple sites coming online each, each month.

What do we do with the CO2? We make dry ice. That's great when you need CO2 for different things. But really, we want to get rid of it. In the UK we don't have any geological stores.

In the UK mineralized CO2, 25,000 tonnes a year – that generates a carbon removal credit. As the CO2 we are capturing is biogenic we've had to go Europe because they've got stores. We've got a contract signed with Stenlille gas site in Denmark, where we're capturing CO2 from German biogas plants, Danish biogas plants and we're going to send some CO2 from the UK because that's a really cool thing to do and because it's the only geological store in which is legal to do that to today because of the London protocol issue – our store is a land-based store.

We are building massive amounts of these systems and we can get funding now because we've got the, the stores signed up. We've got the customers wanting to buy carbon removal credit because they want to offset their scope three emissions. We see it actually happening.

I think what I can bring to this, and what our story can bring to this, is that if you if you jump into something and you've got no other option but success, you will make it happen.

Don't rely too much on what the government policies are, because if we did that, we would be one of many other companies saying "we could have done that but we didn't, because the UK government signed up for geological storage for track two. so we're stuck"

So what? We've had to find places where you can move CO2, like a mineralising site that we've got in the UK and take it to European stores.

So that's it, that's what we're doing. Our model is basically build carbon capture systems and installed in biogas plants, wherever the store is and remove that CO2 and bring the CDR market to a place where it needs to be, with larger volumes coming through.

That will encourage competition, which is okay for us because there isn't any right now. We need more competition in the space but we need to really, bring the CDR market to a position where it comes out of the voluntary market.

So it's a really nice trade for reduction of scope three emissions.

I guess there would be questions later on, but that's my ramble over and we've got to know each other and hopefully next time you'll meet my, taller, smarter, but grey-haired brother.

Nick Gaskell

Abrdn, Senior Sustainability Investment Analyst

Hi, everyone. I'm Nick Gaskell. I work at Abrdn an asset management company based here in Edinburgh and, I work within the sustainability group focusing on climate change. and that's within the investments.

What we're going to talk about today, or my provocation, is around carbon credits and the carbon offset market and why we need it today rather than in the future.

Two things can be true at the same time. Those two things are that the energy transition is happening. It is accelerating, but emissions are remaining elevated. At Abrdn our base case is that's going to continue for about 5–10 more years, but for at least a medium-term kind of projection on that front.

The problem with that is warming is a function of cumulative emissions. Even as the energy transition is going on, global warming is going to continue.

Here's some data to back that up. Solar and wind is consistently growing at about a compound annual growth rate of 20% over the last 25 years. Just last year solar generation grew at 23%. But despite that, the share of solar in 2023 only increased by 0.9% – of the electricity generation mix.

So, in 2023, solar increased in absolute terms 307 terawatt hours. Wind was 206, that's about 513. Total energy demand increased 620. So it's not keeping pace to added energy demand. From a grid intensity point of view, emissions fell, but in total emissions terms they increased.

When we take a step back, the energy transition has really just been focused in the power sector, so the electricity generation, that's 25% of the whole energy system, the rest of it being molecular fuels like oil and gas. We need that share to increase from about 25% to 60% and we know how to do that – which is the good news. The bad news is supply chains aren't ready for that. As an example, substation transformers used to take about a year to be delivered, now that takes about four years.

The energy transition is broadening. We've got from the power sector to the transport sector. We've got EV sales in China now at 50% – so penetration. Those are starting to be exported around the world, but it only makes up 3–5% of China's fleet of vehicles at the moment.

What that means from a mineral intensity point of view is we need six times more minerals as we move from a fossil fuel based economy to a mineral intensive economy. That does give us circular economy solutions, where we can start to do recycling at scale as and when that comes – but that's still going to take quite a number of years. It takes the average mine 16 years to get to production stage.

We need to start opening a lot more mines and do it in a sustainable way. So that transition is happening against the backdrop of increasing energy demand and of course now AI – Microsoft's emissions have gone up 30% since 2020. All of that is going to also require a lot more minerals.

The reality is just energy transitions are very slow. If you go back and look at the Industrial revolution, for example, it took coal 75 years to get to a 10% market share, it took oil about 78 years, natural gas 70 years. Solar and wind is at about 5% share after about 44 years, if you start at around 1980.

The goal ultimately in the energy transition is to mitigate the physical impacts of climate change, which means mitigating temperature.

Because of that we need to move the consensus away from when we get to the end state of net zero, which is the goal – the first thing you start to offset a residual emissions. In different kind of scenarios from the IPCC – obviously there's a range – but pretty consensual to say that we need to start removing about 3 to 5 gigatons when we get to net zero end state.

The assumption there is that we're on a pathway already to achieve our goals, which we're not. It also assumes that once we get to that end state, we're going to have a high integrity carbon offset market, which again, we're not.

We need a carbon offset market that works today.

In Scotland, 85% of peatland is degraded and that peatland emits greenhouse gases to the tune of about 15–20% of Scotland's annual emissions.

Immediately we have an opportunity not just to start removing carbon – woodland creation for example – but also peatland restoration. The cost of that is currently around 20 to 25 pounds sterling per tonne, so it's actually quite affordable and when you look at carbon prices – compliance carbon prices mostly affecting utility companies in the UK – that's about 40 pounds per tonne. In Europe, that's €70 per tonne. Uruguay, Switzerland, Sweden and many countries have carbon taxes above $100 and €100 per tonne – so it's more economically efficient as well.

And they also come with a range of co-benefits for local communities, improving biodiversity and more, as well as adaptation when it comes to the physical risks of climate change. It's really, really crucial that we start to have a mindset shift in terms of how do offsets and that carbon credit market have a role in the transition to net zero.

There's a long list of things that need to be improved, I'm not saying that market is perfect – we need to scale it up but we need to scale up with high integrity.

My starter-for-ten wish list is that we need a carbon market that actually puts a higher price premium on quality. We need a minimum high bar of environmental integrity.

And I think to get there we need buyers of these credits, typically large corporates, to start disclosing and with a lot more granular detail, in terms of the price of which they're buying carbon credits, the type, the registries they're buying them from, the location, etc.

The carbon offset buying part of the of the corporation needs to be in the CFO/Treasury office rather than in Corporate Social Responsibility/Public Affairs/Marketing, which is often the case at the moment. It needs to start being a future carbon liability that the corporate is starting to price in.

We need financial integrity and for that we need regulators to enter the market – and we're actually starting to see that. The International Organisation of Securities Commissions (ISOC) – which is essentially sets the guidance for exchanges around the world – are starting to work on this in consultations.

The White House the other day released a joint policy statement talking about the need for this market. The US equivalent for Futures and Commodities Trading Regulations are also putting out their guidance around this. In the UK, HMRC has provided tax treatment guidance, which is a really important step forward.

There needs to be a better understanding for institutions as to what is a carbon credit. What is the legal right that I have if I transact this carbon credit? Financial institutions need to start entering this market. Right from investors/asset managers at the project financing stage to banks doing settlement transactions. Making that more efficient, creating a more transparent market mechanism.

There is a long list of things that need to happen but I think first and foremost, it needs to be a change in perception as to what carbon offsets are and the opportunities they can provide, and their role in actually speeding up the energy transition rather than what is often seen as – slowing it down.

Chris Ramsey

Pole to Pole EV, Founder

My name is Chris Ramsey and I'm a little bit different to people in this room in the sense that I'm on the consumer level. I am the consumer. What I can do is I can talk to you about the advantages, I can talk to you about driving around the world, I can talk to you about polar bears – and that's normally what I do. But it's so great to be here and talk to you about what we need to do, or question you about what we need to do, to take the consumer on this journey with us. After all, we are all consumers.

I would like to first, thank you for being here. I am going to talk about being brave and being bold. You all are brave, you are in this room because you want to be a part of the solution.

There are some amazing technological solutions and amazing investments coming from around the world, globally, to be a part of the change in this world. I'm just going to touch on things like EV charging technology: the resilience, the way, that we need to move forward and is it adequate? But also, just look at how we change our relationship with energy and space.

Who here has an EV? If not, what, as a consumer would make you make that change? If you make that change then not only are you implementing a solution but you will make other consumers out there, like yourself, come with you in this change.

I'm just looking back within ourselves because we're in a situation where around $1 trillion of EV sales are going to come to the market by 2025 and there's going to be over 100 million EVs on the on our roads compared to what is on the roads today. Globally.

We have a charging infrastructure but we also have a lot of perceptions around charging and around range. Ten years ago I was driving an EV and I had a range of 65 miles, ranges now are over 350, nearly 400 miles of range. The perceptions that I hear today are the range is the same as it was ten years ago. There infrastructure out there, it's a growing infrastructure and it's enough for the current market – but to meet future demand, it needs to get better.

My wife and I recently came back from Antarctica. We drove an electric car from the 1823 magnetic North Pole all the way to the South Pole. We've driven from London to Mongolia. We've driven annual events all over the world and tested every single part of infrastructure there is on this planet.

We've seen the good and the bad. We've been in situations where we have to charge from a domestic socket, in situations where we charge from rapid charger – but not everybody sees that. Not everybody understands. So we pass that information to people and say, "here are the facts".

We had in Romania and Costa Rica, fantastic infrastructure worked 100% of the time. Here in the UK, infrastructure doesn't work around 100% of the time.

We have some un-resilient networks, we have the same in America, we have the same in Mexico, we have the same in different places. So how do we make those networks resilient with all of the investment that's coming?

I am interested to hear your ideas, I have my own thoughts, thoughts that I would like to share with you because we have one opportunity. I see it one opportunity, we've got a great investment coming and we need to get it right.

There's a lot of mentality shift that needs to happen. How can we make that happen? How can we influence other people that haven't made that switch to make that switch? How can we change those perceptions? How can we change those misconceptions?

I also want to ask the question, do we need to change our perception of how we use land and urban space?

We've looked at putting chargers in the ground and that's one solution. We've put loads of chargers in the ground in on-street parking.

But we're looking at communities and we need to take consumers with us – we have communities where people can't charge because they don't have access to a ground-level power source because they live in a flat or tenement, for example. How do they access charging?

We have amazing space in councils and in businesses with amazing space in car parks, frequently left unattended and unoccupied in the evenings during the day – underutilized spaces and new way for businesses to increase revenue. Is there an opportunity staring us in the face? We know already that you can put charges in the ground.

We have to put things in place that gives both community benefits and business opportunity.

Here is a revenue opportunity for businesses and councils and a benefit to communities to those chargers being in unused carparks and a further benefit to everyone from renewable energy being there.

The consumer will see the benefit to them and at the end of the day, to make the shift – the consumer needs to see a benefit.

And that brings me on to carbon capture. It brings me to offshore wind, onshore wind or onshore renewable energy sites. Again, we're in a situation where a lot of investment is going into this, which is great. I love to see investment in renewable energy – but I don't live in the communities where a lot of this energy being stored and we have to a rely on communities to accept the planning application or coastal planning approval process, to accept that technology.

And if we think a little bit like an individual who is living in their retirement cottage in a beautiful part of Scotland, or anywhere in the world, and suddenly there's a carbon capture facility, a wind turbine, wind farm, solar farm coming?

They see the fact that there's just this big facility, this big building being put up in their home but we need them to see the benefit of that.

If a facility goes in there and says: "Hey, it's coming, but we are going to give you something back where you're going to make sure that we can improve your community and give make sure you see the benefit from this building being here" communities are far more likely to come with you on that journey.

I think we need to really think differently about how we engage with the consumer and how we engage with our land and space because we need to take the consumer with us. How do we empower people to be a part of the solution? To be bold?

Investment plays a huge part in that. Personally, as an individual that has tried to make things happen and investment in not being there – it's great to see that we have investment coming, but investment needs to be bold –some of these investments may not give you an immediate benefit or immediate return.

I challenge people to be bold and think differently and think about solutions that you can implement today, tomorrow – see the benefit for the future. See the benefits for the next generation.

As humanity, one thing we excel at is resisting change and resisting what it takes to make that change. We need to be pioneers in this field.

You'll be pioneers in your business and you may face opposition. You will find a way to get people on board.

So be bold, be pioneering, push forward because at the end of the day, we have to find solutions. If not for us and our generation – for the next.

We need to take the individual along with us – through investment, through businesses, through whatever we do in life, whatever we do to enhance the planet – we have to take people with us.

Panel Discussion

HB: Firstly to Nick and Richard – with regards to Carbon Capture and Storage (CCS), what is your experience, both in the industry and in finance, of accusations or perhaps provocations of greenwashing – what is your messaging and how what has been successful there?

RN: The first thing that often springs to mind is accusations of greenwashing and allowing oil and gas companies to continue operating as normal and that needs to be addressed. I can't speak for all the CCS companies out there but I know every part of our business extremely well and I can tell you. We are capturing biogenic CO2.

I'll give you an example. North British Distillery, it's half a mile from here and has been operational since 1887. They've been taking grain for multiple already and fermenting it, and it goes up into the fermentation tanks and is vented, that's been happening for many, many years.

The CO2 captured by photosynthesis into the crop, transported to the distillery, broken down and the CO2 is vented. That's been happening.

What we're doing now is basically vacuuming that CO2 condensing and compressing it then sending it to somewhere where it will no longer be a gas CO2, in the atmosphere. So either materializing it or removing it from atmosphere altogether.

The amount of energy that we use to do that is 180Kw per ton. The energy that we use to transport it is calculated and that's reduced off the lifecycle analysis and the energy to sequester it either by, mineralising it or pumping it into a store is calculated and that's also reduced off the lifecycle analysis.

When you are buying a carbon removal credit, for every tonne of CO2 is about 920 kilos of CO2 that you actually gained as a carbon removal credit. To help the customer feel satisfied with that, we have verification bodies.

What we've also done is we're working with an American bank called Northern Trust to handle $13 trillion. They have access into everything that we do. They track or CO2 tankers. They track our, carbon capture systems. They even have seismic data on the store. They can track where the mineralized CO2 goes and what bridge or which which road it goes into or which building it goes into – they can show that information to the customer.

That is, for us, the only way, that way, because we're not politicians, we just do it and it's a very open book. We even publish our board minutes to our customers. We show our profit margin, which is 30%.

We're an extremely open book and you have to be because the trust for the customer in you is the most important thing that you can have.

We're not going to sort of lobby for anti-greenwashing. We're just going to say exactly what we do and give an open book to the customer.

We enjoy getting challenged and we've had 100% track record of bringing in anti-carbon capture opinions and turning them around to really getting it and appreciating the fact that our business and existence reduces amount of CO2 in the atmosphere. Without it, that CO2 is just going up from the fermentation tanks.

NG: Without a doubt of, greenwashing occurs. I would say there's two sides to the story. One side is on the supply side – the type of projects that are getting carbon credits and the carbon programs. That's one element of potential greenwashing, i.e., the project hasn't delivered on actually removing carbon or reducing carbon, etc.

Then you have greenwashing on the buy side – which is the corporate purchasing the credit. I actually have less worry there because as long as there's good disclosure – corporates should be disclosing their gross emissions and their offsetting emissions, the price they paid and the details around those projects.

If you think about a corporate has bought £20 per tonne worth of credits – if a rational economic actor – they would decarbonize anything cheaper than £20 per tonne. So if something costs £15 pounds per tonne to reduce their scope one emissions, they would do that – in theory at least and hat's why I think this should move to the CFO/Treasury office in my opinion.

On the supply side, a lot more work needs to be done and I think, to be honest, there's a lot of accidental greenwashing that goes on. That's why I think this market needs regulators and institutions to step in, to start bringing clarity. This market came out of the Clean Development Mechanism and a lot of these carbon programs are actually NGOs at birth, they've got a resource problem in terms of the constraints that they have in order to actually go in and monitor, verify and keep track of all these projects, so that's an evolution.

What are offsets? At the end of the day it's pricing and carbon. You're creating an economic incentive to reduce the amount that you emit. I think with the right regulations in place and the right kind of mindset and as long as that's the goal of everyone that's involved – then I think we can get over some of these hurdles around greenwashing.

HB: For Chris, in the US our department of energy has a joint office with the Department of Transport because, again, we realize just developing the technology is not enough, we have to deploy it. This joint office is going not only around the country but around the world. They've been to the UK recently looking at how you do charging infrastructure and I'm hoping Chris can tell us a bit about the messaging.

What are governments and companies getting wrong and, and what do you think we could do to get it right? What is what is that key? What are we missing?

CR: We have one shining example of this right here in Scotland. Dundee City Council have worked with the government and local communities quite closely to develop charging infrastructure that not only supports public charging but supports communities and also supports their fleets. I think the taxi fleets in Dundee are pretty much 100% electric, the council's fleets are on it, pretty much 100% electric.

They have developed an infrastructure that works for them but they can also work for the community.

When we look at where we have challenges, when you look across the board, there's a number of situations in various different countries. There's Mexico, the US, the UK, Belgium and other and other parts of Europe as well – where the investments come, the technology is there and there's been just a rush to put things in the ground a rush to put things there without thoughts about the technology and how to how the consumer interfaces with that.

We've seen the birth of the apps and the RFID cards various different things – when we've got a simple solution already, chip in, we've had that on everything. That is a simple solution but whenever you involve apps or RFID cards – generally there's some kind of faff or frustrations and charges. I've seen that all around the world and that's something we need to overcome. It has to be easy for the consumer.

Stepping away from just the challenging infrastructure is, again, the getting consumers on that journey, getting people in the cars. We've got a big challenge in the automotive industry as well – everybody's in a different state of transition some moving faster than others. We need to work on the educational message, the education, the training within the networks.

We've got a lot of work to do around that because we can't build consumer confidence in charging and cars if we don't tackle that as well.

Round Table Discussion

Points raised by partcipants:

We ha ve talked a lot about regulation. I think the public perception is key and actually culture is key. If you look at the big societal changes in the last 20–30 years, we do not change behaviour because of regulation, people will go to the letter of the law, particularly businesses to the law and why would you expect them to go any further? What we need to do is have that discussion that we've had about other aspects of our culture. I use the example about drink driving. It used to be socially acceptable 40 years ago, it's not socially acceptable now. The law doesn't really matter, we stop our friends doing that because it's not acceptable if they drive. Similarly, you've seen the campaign about smoking. How smoking has changed in perception over the last 40 years is not really about law, it's about how we do as a society. So really it is on the medium. It's on the people who want to make the change argument to look at a much broader cultural piece.

People will only ever go to the limit what you ask them to do and they'll find creative ways around that, frankly, how you change the mindset and really have that discussion? It should be that when I go to spend money on something for example, a new boiler. People should be saying to you, "what the hell are you doing? Don't get a new boiler, get heat pump!"

It is all individual choices for quite a lot of this stuff. We need to make sure that it's appealing to the consumer. People need to get excited about this new technology. We need early adopters to spread the word and we need the media on board with positive messages about technology and the benefits that it can bring.

People need to see things in action to understand how they really work. Take EVs as an example. People have a lot of misconceptions about them – about range and charging. Salespeople often put people off choosing an EV as a result. When people see them in action, get to touch one, drive one – hear about someone travelling across the world in one. That's where they start changing their opinions. Dundee is a great example of the city council providing leadership and showing that they work.

It is going to be very, very difficult for us to achieve our net zero goals. It doesn't mean that we need to give them up but just that we need for them to be in perspective Let's not set unattainable goals and set ambitious goals, but goals that are achievable.

People need to understand how technology works, what it can achieve and where its limitations are. For CCS, is this, an industry that could scale very quickly? Could it make a substantive difference within a decade to the carbon and that carbon emissions, is it a technology that's going to save us?

Surely we should be challenging consumption and what we mean by that is actually reducing the vehicles that are going onto roads and improve public transport. We don't want to replace all fossil fuel cars with electric vehicles, we want to how we can pedestrianize cities, how we can make them the public transport system a lot better and make places more environmentally more friendly for pedestrians and people to move around.

The EV isn't a perfect solution, however, it is an interim solution and technology can move quickly. EVs efficiency levels for how the batteries have improved now allow just under 400 mile range and that's over about ten years. In the last 12 years they are now over 90% efficient. Compare this to a combustion engine which is about 42% efficient after around 140yrs of development. What you could take away from that is that in another decade we could be looking at another form of technology. We mustn't close our minds off to what's to come. EVs are a solution just now.

One of the big issues that we face, from a capitalist perspective, is that capitalism is fundamentally broken. We think far too much about the shareholder and not enough about the client and the employee. We have this market where everything is aimed at pleasing the shareholder. This room has alluded to the fact that we need to show a profit. But we're not going to fix this problem because the shareholders – the investors are going to have to realize that actually, for them to be successful in the long term and bear in mind the street and the Square Mile are very short-termist, they need to start looking at the long game and realizing that actually, companies are going to have to give us less of a return and invest more capital in improving that.

We talk about disruptors but are we looking at the governments and how they should be disruptors? You see the energy industry being funded, or given incentives, to charge the hundreds of millions of pounds and they're earning hundreds of millions of pounds a quarter alongside an industry that's trying to do good in the world that is not receiving anywhere near that. That is a very simplistic view of it and there's a lot more to it. But it should be governments being disruptors in the energy industry and being bold and be brave within that and challenge those industries. There's so much more good that can be done in the world.

The way I would design a high-integrity system for carbon credits and removals is by linking compliance markets and carbon markets. The UK has an emissions trading scheme with the US at the moment – currently it's predominantly utilities that actually are exposed to that carbon price but over time more industry will be exposed. If you think about it, that revenue of those carbon markets goes effectively to its government. It would make sense if that revenue also supported nature restoration that has co-benefits along a wide spectrum.

Heather Bell Closing Comments

A lot of themes came out today, a key one of which is bringing people on board.

I really liked the example of Dundee City Council – leading by example at a government and city level on electric vehicles and emissions – as a way to bring people on board.

We talked about using nudge economics to change behaviour and that we have to look at how we as humans are wired. That is perhaps how we feel if we feel like we're being misled, or if, for example, we feel like governments are making promises that they may not keep. And the impact of that on getting people on board. There is a lesson for those of us in the public sector there and industry on how we are presenting ourselves and how the public will perceive us.

There were a lot of themes about increasing our trust, our transparency, our certainty.

A lot of big questions came out today. Is capitalism broken? Maybe the next, *Climate Co-Lab* could take that one on – but I won't take that on today! There are a lot of challenges. Can we do this ourselves? Who do we need to bring on board? Are we actually doing the things that we say we'll do?

I will wrap it up to say thank you so much to Richard, to Nick and to Chris. Thank you all for participating, for coming, for being here and for being present.

Thank you.

Participant List

FIRST NAME	LAST NAME	ON BEHALF OF	ROLE
Andrew	Aldridge	Partner	NovAzure
Eric	Alter	Marsh Group	Senior Vice President Risk & Cyber Engagement Leader - UK Corporate
Christabel	Barrowman	Edinburgh Science	Development Co-ordinator
Heather	Bell	US Embassy	Department of Energy Attache in London
Richard	Bellingham	University of Strathclyde	Executive Director
Mark	Biagi	Bentley Systems	Senior Director – Energy
Gemma	Bone Dodds	Scottish National Investment Bank	Director of Insights & Policy
Jessica	Briggs	Edinburgh Airport	Head of Sustainability
Jason	Conlin	Double Eight Consulting	Managing Director
Barry	Fisher	Keep Scotland Beautiful	Chief Executive
Simon	Gage	Edinburgh Science	CEO
Nick	Gaskell	Abrdn	Senior Sustainability Investment Analyst
Anna	Graham	The Scotch Whisky Association	Head of Environment, Science & Innovation
Sinaead	Hayman	Cirrus Logic	Presiedent of Cirrus Logic Clean ERG
Alan	Hendry	Mott MacDonald	Director of Sustainability
Jack	Henry	Green Cat Hydrogen	Development Associate
Patrick	Hogan	US Consulate Edinburgh	Programs Manager
Christiane	Hullmann	German Consulate	Consul General
Valentina	Kretzschmar	Wood Mackenzie Ltd	Energy Transition Director
Sefton	Laing	Baillie Gifford	Senior Climate & Environment Specialist
Adam	Liddle	Roslin CT	Head of Sustainability
Laura	Lowden	Lloyd's Banking	Associate Director
Claire	Mack	Scottish Renewables	Chief Executive
Stephanie	Maia	Edinburgh Science	Climate Engagement Manager
Robert	Marrs	Wood Mackenzie Ltd	Head of ESG
Raquel	Martin Trivino	Sweco UK	GIS & Digital Advisory Team Manager
Scott	Murray	Prydis Wealth	Director
Michael	Napier	UK Government in Scotland	Team Leader - Net Zero, Energy and Infrastructure
Richard	Nimmons	Carbon Capture Scotland	CEO & Co-Founder
Krista	Peterson-Hopgood	Edinburgh Science	Marketing and Digital Officer
Ross	Powell	Palladium	Partnerships and Business Development
Chris	Ramsey	Pole to Pole EV	Founder
Dai	Richards	Hitachi Energy	Head of External Affairs
Hannah	Schlesinger	Edinburgh Science	Director of Development
Martin	Tangney	Celtic Renewables	President
Koen	Van Eynde	US Embassy	Energy Analyst
Charlotte	Young	Fleetwood & Young	Director

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