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Transcript

The Circular Economy: Redesigning the Future

Dame Ellen MacArthur

Ellen MacArthur Foundation

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Bernice Lee:

Good evening, everybody, and welcome to this event tonight at Chatham House on 'The Circular Economy: Redesigning the Future'. My name is Bernice Lee; I'm the research director for Energy, Environment and Resources here. It is my great pleasure to introduce Dame Ellen MacArthur today, who is going to talk to us about this very important topic.

I do not believe that Dame Ellen MacArthur needs an introduction, but I did spend the whole afternoon learning the language of sailing, that I am not familiar with. Here she is speaking in her capacity as a founder of the Ellen MacArthur Foundation, a charity that tries to accelerate the transition towards a regenerative circular economy. It works in three areas of business, education and communication. She is a retired British sailor and in 2004-05 she broke the world record by sailing around the world singlehanded, non-stop, fastest.

This is a topic very close to our hearts here in Chatham House, in the work that we do. I very much look forward to your presentation, which I have never seen before but I understand from everyone who has seen you that it is the most exciting and invigorating talk they have ever seen.

Ellen MacArthur:

Good evening, everybody. I'd like to start really at the beginning, because my journey to this stage is not just the work of a foundation nor is it just sailing around the world – but the two in many ways have very much tied together.

I'd like to go back to my childhood, because when I was four years old I had an opportunity to sail for the first time. I grew up in Derbyshire – I'd never really seen the sea before. I had the chance to travel to the east coast of the UK to sail with my auntie. I will never forget the feeling of excitement that I felt when I saw the sea for the first time, when I saw the boat and climbed on board the boat and discovered this little world that we'd be spending four days on. But the most amazing feeling was the feeling when we hoisted the sails, because as a four-year-old girl that was the greatest sense of freedom that I could ever imagine.

That changed my life entirely. Despite growing up in Derbyshire, I set about spending all my spare time reading sailing books. Each book in the library at school I'd taken out six or seven times if it concerned sailing. I wanted to learn everything I possibly could, and I knew there and then that one day I wanted

to sail around the world. I had absolutely no idea how to make that happen but I knew one day I would do that.

So I took what steps I could as a seven, eight-year-old girl, nine, ten, going into secondary school at 11 – the steps that I could to get closer to that goal. For me, it was saving my school dinner money change. Right through secondary school until I left when I was 17, I would have mashed potato and baked beans for lunch every day, which cost 4p each; gravy was free so I would pile the gravy on the plate; and the rest of the change I would save every day, until the pile on top of my money box reached a pound. Then I would drop it in and I'd cross off one of the hundred squares that I'd drawn on a piece of paper. Each pound got me one step closer to the little boat that I could sit in the garden dreaming with.

I left school at seventeen and went to work for a sailing school. Asked as many questions as I possibly could to learn. Three years later, sailed across the Atlantic. Just five years after leaving school, I was sitting in a design meeting, designing a boat on which I was going to sail solo, non-stop, around the world. I could not believe that I was living my life. The journey to that had been difficult. People often say that sailing around the world is difficult; I can't disagree with that, but finding the funding when you have no background in sailing – that's really hard. Thousands of letters, many, many meetings, all that mixed in with trying to get as much experience as you possibly can in the field of sailing.

We built the most beautiful boat: *Kingfisher,* launched in 2000 at Auckland Harbour. I was so happy when she was built that I sailed halfway around the world on her to train for my first race, a transatlantic race. I was at sea for two months, loving every single minute of it. Getting to know the boat, getting to understand the boat, learning how she functioned. I won our first race in 2000 but it was really only the precursor to that big race, that big goal: to one day sail around the world.

The Vendée Globe, November 2000 – that race was everything I had ever dreamt of. You go to sea for three and a half months. You're surfing on huge waves in the Southern Ocean under moonlit skies. You see the albatross of the Southern Ocean. You race against some of the best sailors in the world. You are on that boat 24 hours a day, seven days a week – it does not stop at all. There is no bedtime when you put your pyjamas on and get in your sleeping bag. You cross the start line – you can't switch off until you cross the finish line, full stop, that's just how it is. Whatever comes your way, you deal with it. You sleep more in the day than at night, ironically, because at night

the sailing is harder. You sail just as fast but you obviously can't see where you're going.

And if I said to you all now: go off and find everything that you need, everything you need for your survival for the next three months – go off into London – it's quite a hard challenge. That's what we do when we set off around the world; we take everything that we think we will need – but the minimum, because if the boat's heavy you won't stand a chance of breaking the record or winning the race.

So you enter a different world, and it was a world that I loved. It was a world where you see sights like this iceberg. You could have sailed *Kingfisher* into those caves; they were a hundred foot high. That iceberg was a kilometre long. You see these things, you're in awe of them – you know you're probably the only person who will ever see that iceberg. There are no other boats in the Southern Ocean. You're 2,500 miles away from the nearest town. Many people think there are support vessels with you – there's no one. In the Vendée there's the other competitors, but they can't get you off the boat. If you need to get to a hospital it takes five days for a navy ship to come down from South Africa, New Zealand, Australia, to get to you, then five days with you onboard to get you back into a hospital. So you really are in some of the most isolated places in the world.

I loved every minute of that Vendée. In a weird way, one of the hardest moments of that entire race was stepping off the boat at the finish line, because at that moment my life had changed forever. My goal had been to sail around the world. My goal hadn't been to be someone who was recognized in the street. At the finish were hundreds of thousands of people, and dealing with that was actually quite hard. Within six months of stepping off *Kingfisher* at the finish line, I decided to go around the world again. The second time though, that was to try and be the fastest person ever to sail solo, non-stop, around the world.

We began that incredible process once again of designing a boat and building a boat to complete that task. At that stage nobody had ever been around the world non-stop in a multihull – a boat with multiple hulls. They'd all failed, because the boats are faster and more dangerous. If you imagine driving a car – when you're driving a car slowly, it's not that stressful. The faster the car gets, the more stressful it gets – 50, 60, 70 miles an hour, you're gripping the wheel and you're really concentrating. Take that to 80, 90, 100, 110 – white knuckles. Your focus is keeping yourself alive and the car on the road. When

you go around the world quickly in a multihull, that's what you face: the faster you go, the more stressful it is.

And this was to be the fastest ever. This had never been done. Yet while we built her, a Frenchman took a boat 25 per cent bigger around the world, designed to be sailed by a crew of 10, and took the record of 93 days that I was trying to break right down to 72. So the bar was very, very high.

Just to give you an insight into multihulls: they're quite lively. They're actually very wet. This was a training sail with a French friend, Alain Gautier, just off the French coast. This was not a training sail of mine, but there were 11 guys on this boat when it flipped upside down – 11 people. That is not the goal, to flip them. It's very expensive when they go upside down. If you see the figures hanging onto the net on the right-hand side, it makes you realize the size of the boat and the scale of the boat. To put things in perspective, I could climb up inside the mast of *B&Q*, that's how big the mast was. So these are big beasts. She was much bigger than this boat here.

So things go wrong very quickly on a multihull. Actually, I was on that one, and I experienced that for myself. I was inside, getting something to eat, about to go on deck on watch for three hours. There was a tiny little knock and then five seconds later our world was pitch black because the boat had flipped upside down and all the windows go underwater. You realize how small that margin of error is. So when you race around the world on a multihull you literally sleep with the ropes in your hands, because if you don't release them when the wind comes too strong you will catapult over and you'll flip upside down.

When you leave for that journey, like the Vendée Globe, you take with you everything that you will need for your survival. You manage the energy in the batteries, because if the batteries go flat, if the batteries go too low, the autopilot switches off. The autopilot steers the boat when you're sleeping, when you're cooking, when you're managing the navigation. So if the batteries aren't looked after, if the generator isn't run, you'll be upside down within five seconds.

So you live at the place of the resources you have. You manage everything you have. Food, there is only so much. Water, you make from a desalinator – that needs diesel, because that needs energy. It took 475 litres of diesel – half a ton of diesel – to get a sailing boat around the world in 71 days. That just powered two computers – and not the screens when they weren't being looked at – and that autopilot. You gain a real value of those resources and you understand – and for me this was the first time in my life I understood the

true definition of the word ‘finite’. What you have out there is all you have and if you run out there is no more.

The record was successful. I crossed the finish line in Falmouth – extraordinary experience. But I made a connection. I made a connection in my life for the first time which was outside of sailing – because if you’d asked me 10 years ago what I’d be doing for the rest of my life, I would be sailing around the world. That connection was: making the translation of that definition of ‘finite’ on the boat to the definition of ‘finite’ within our global economy.

Our economy is driven using materials which we have once in the history of humanity. It’s driven by that. And I began a new adventure, a new journey. I started to look at a new horizon. In a way, it’s a bit like picking up a stone – or kicking a stone actually, not really picking it up, kicking a stone and seeing something beneath that and knowing there and then that you have two options: you either put that stone back down, cover that thing that you’ve seen and carry on with your dream job of sailing around the world, or you put it to one side and you learn, and you find out more about this thing that you’ve seen for the first time. And for me that was: how do we use our resources globally?

I began a six-year journey of speaking to scientists, speaking to experts, speaking to teachers, speaking to economists, to understand this massive, complex question: how do we use resources within our world? This was during part of that research – this was in a coal-fired power station, standing in a burner, 180 foot tall, goes to 2000 degrees to drive the turbines. Amazing to see that. Amazing to see the scale of what we build to create energy that’s probably lighting the screen here this evening for us all. It was incredible.

I looked at energy, I looked at materials. I looked at coal – I wanted to understand how this worked. Coal was a subject that was quite close to my family, because my great-grandfather had been a coal miner – he came from the Midlands – and he spent 50 years of his life underground. This is him. When you see that photo you don’t see someone from our era, that’s someone from another age. Nobody wears trousers with a waistband quite that high these days. That’s me with him. By the way, they are not his real ears – they’re his Spock ears he put on for his grandchildren and great-grandchildren. But I remember my great-grandfather vividly. I was very close to him. I remember him talking about his mining stories, about the fact that he worked underground with ponies – pit ponies that used to pull the coal out of the pits. When those ponies retired they would live in the fields around the

mouths of the pits and the miners would save them the crusts of their sandwiches, because they were colleagues and they had worked together for so many years.

Yet when I was on this journey of research to find out about resources, one of the places I visited was the World Coal Association. There in the middle of the homepage on the day of my visit was a figure: 118 years. No one knows the exact number of years of whatever we have left. We do know that it's ultimately finite. But what struck me is when I looked at that figure, I thought: that's outside my lifetime, but my great-grandfather was born exactly 118 years before that year. And I sat on his knee until I was 11 years old. It's nothing. It's nothing in time. That made me make the decision that I never thought I would make in my life, and that was to leave the sport of sailing behind me to focus on a much greater challenge: to try and understand how our global economy can function in the future.

I realized it wasn't just about the coal and oil that we hear so much about but it's also materials – materials such as were represented in the 2008 *New Scientist* report. There were figures like 13 years for indium – in every LCD screen, our mobile phone screens, computer screens – not currently cycled at the moment; 40–41 for tin and zinc; 59, uranium; 60, copper. These numbers were not so great. Again, we can't put a precise number on them, but we do know they're coming out of mines and it's getting harder and harder – and importantly, more and more expensive – to extract these materials. And it's having an impact on their prices. We've seen for a hundred years basic commodity prices decrease. Food's got cheaper, clothes have got cheaper, materials have got cheaper, for years and years and years. In 2003 there was an inflection point and those materials started to get more and more expensive. We have seen a steep rise in the cost of those materials – and not just the price, but the volatility. They are becoming much less predictable.

To put that into perspective, in the run-up to this time last year, your average European car manufacturer had seen an increase in raw material prices of €500 million – half their operating profits wiped out by something they ultimately have no control over, nor can they, because their business model is based on buying materials, making a vehicle and then ultimately that vehicle is out of their control. It goes out into the market and they buy new raw materials to make a new car.

We use these materials at a faster and faster rate. There's just a few on here. But the speed of consumption is extraordinary – we have increasing population, we have a greater and greater need for these materials. Whatever

those materials are, one thing we do know is that that line can't go vertical, because it's based on finite materials – materials we only have once. We live in a world where our population is increasing by a city the size of London every 38 days. Perhaps more importantly, we have 3 billion new middle-class consumers coming online, having the right to have the same equipment – the clickers, the computers, the screens, the transport, the facilities we have in our houses – as us, but they also create a demand for those materials.

When we look at our current economy, our economy is driven in a very linear way. We take that material out of the ground – like the car manufacturer – and we make something out of it, and ultimately that material gets thrown away. Some of it gets cycled but it's that very linear system. It's a straight line.

When I spoke to these experts looking for solutions – what can we do about our global economy, what's the goal, where are we trying to get to, what's going to function – most of the narrative was about being efficient. We need to be efficient with our use of resources – we need to make a car with 10 per cent less material in it, we need to make it using 10 per cent less energy. Then we'll be less susceptible to these price increases. But if you look at that in the long term, if you do 10 per cent every year for 10 years, does that mean that in 10 years you make nothing out of nothing, with no employment and no company, because the goal has been to reduce every year? For me, that wasn't a goal. It bought us time – it was essential in the transition, because we knew those materials were finite. But to me it wasn't that goal, it wasn't that thing to aim for, because ultimately in the long run we were just buying ourselves time.

Then I met several people who totally changed my point of view: a Welsh education expert, Ken Webster; a Dutch CEO, Stef Kranendijk; and a German scientist, Michael Braungart. They saw things in a very different way. This is Stef's business – the Dutch CEO – he makes industrial carpet tiles. He didn't go to his workforce and say, 'Okay team, what we want to do is we want to make a carpet more efficiently.' He said, 'I want to make a carpet that's made to be made again. I want you to design me a carpet that I can get back, reprocess and turn into the next carpet. I want to be able to disassemble the top from the base. I want to be able to depolymerize and re-polymerize that yarn, and I want to melt the base down and make it out of material that I can do this with and turn that into the base of the next carpet. And I want to do this using entirely renewable energy by 2025.'

It was an entirely different business model. He was looking at shifting the entire system. He didn't actually want to sell his carpet, he'd rather lease it –

because he wants to guarantee he gets those raw materials back to go back into the system so he can fuel his business in the future. He's a €55 million company, not a small company at all.

This to me was so inspiring because it wasn't just carpets. What about cars, what about washing machines? What washing machine has on the design brief for the designers, 'we need this washing machine to be designed for disassembly, we need to be able to recover all the materials so we can put it into our next machine – or our next iron, or whatever we're producing'? When is that question asked? We deal with it at the end of the life of a product, but we could deal with it right at the beginning and create so much more value within our economy.

It's not just technical stuff like a carpet, like the oil that goes within that or the metals within a vehicle. It's also biological materials: food waste, human waste, animal waste. There is so much value in this. This currently isn't being captured. Some is, in compost heaps; some goes to cover landfills across the country. But this stuff has great value. It is full of goodness, it's full of fertilizer, it's full of potential for biogas. What if food waste, human waste, animal waste, packaging was designed to be non-toxic, biodegradable, could fit through the system and generate more value and fertilizer? Fifty per cent of the people in the world are fed using food which is grown using artificial fertilizer which comes out of mines and holes. It's finite and it's becoming more and more expensive. This is here right now – we all use it, we all create it. It has real value.

The basis of a circular economy is an economy which is entirely different. It's regenerative by design. Within a circular economy there are two types of materials. The technical materials on the right, like cameras, washing machines, cars, plastics – materials that we have once, designed for disassembly, designed to be able to recover the materials and components and products. Then on the left, the biological side: human waste, food waste, farming waste – non-toxic, biodegradable materials that can re-enter that cycle, continuously creating value. The goal is to be able to cycle all materials. That involves many, many changes, and that involves a different way of looking at the way our economy functions.

But what I found about this, what really inspired me about this, was suddenly there was a different way of looking at our global economy. It's a systems-level change. We're not just changing design, because redesigning a washing machine means nothing if it can't go back into a system to be recovered. You look at different business models, you look at different design, you look at a

different way that our economy can function. But it was a goal. And to me as that kid, four years old, I was sailing around the world. I had absolutely no idea how to make that happen but I knew exactly where I was going. The moment I understood the circular economy, I could see a way that the economy could function in the long term. A massive challenge, but I could see something that could potentially work.

It was with that that in September 2010 we launched the Ellen MacArthur Foundation with that goal of accelerating the transition towards a circular economy, with the basic principles, the basic ideas, that if we could split materials into biological and technical, if we could ultimately run that on renewable energy, we would have an economy across the world that could function in the long term.

We chose to focus in three areas. The first area was education. Within our education programme, we work in 14–19 [years old] and we work in higher education. In 14–19, we've produced 700 resources for students across the UK. By this September we'll be in 50 per cent of secondary schools within the UK as a pilot project for a global education programme. So young people can see this different economic way of thinking when they're in school – going into materials science, reverse logistics, becoming marketeers, looking at different ways of passing products through the economy.

We've run projects like Project ReDesign, where we took 800 A-level students from right across the UK; each winning team posed questions about the circular economy, spent a week's internship with our founding partner companies. Amazing. They had a totally different view of how the economy could run in the long term. Within design and technology we've produced a whole range of materials. One student went up to his teacher when we were doing the pilot work and said, 'Sir, when I was doing GCSE D and T (design and technology), I loved D and T but I couldn't think of anything to design. But now having learned about the circular economy, everything I see I want to redesign'.

It absolutely transforms their thinking and opens up minds, which is why B&Q created a youth board – an entire board of young people who sat as an opposite to the main board member for one year with the goal of designing the future of B&Q. What will B&Q look like in the future? What they presented was absolutely not what retail is today at all. They had the ear of every single board member, there were many notes taken in that meeting. It was an extraordinary experiment which has come out with some really tangible ideas that the company is currently working on today.

In higher education, we've successfully piloted an executive education project module which is going to be accessible globally. We're going to be launching much more in higher education within the next couple of months.

Our second area of working is within business. We launched with the support of our five founding partners. We wouldn't be here without their support, and that support came from the model, the idea, the goal of a circular economy. They support us in our work in education, they support us with the work that we're doing within their companies to drive this scale of change. Since September 2010 we've triggered projects within our founding partner companies around the circular economy of an opportunity of over $1 billion towards 2016 – looking at different business models and different design paradigms across those companies.

Then our third area is in thought leadership. So this idea we felt very much made sense, as did our founding partners who came in to support us with the work that we were doing. But a vital element of that work was in that thought leadership. What are the numbers on this? The circular economy makes sense, but does it work economically?

We produced two economic reports. The first was based on EU manufacturing, the second was based on global consumer goods. Within EU manufacturing, we looked at a subset of 48.7 per cent of manufacturing: products that cycle in more than one year and less than 10. We tried to put an economic value on that transition toward a circular economy. I'll run through some of the numbers. The first question that we asked – we asked three – is: does the circular economy decouple growth from resource constraints? Number two: does the circular economy provide profit for business – is it good for business? Number three: is the circular economy good for the wider European economy? Because this first report looked at Europe.

The answer to all three questions was yes. Number one, we looked at: does this decouple growth from resource constraints? We looked at the mobile phone. We looked at five different subjects: mobile phone, smart phone, light commercial vehicle, washing machine, and cotton as a material cascading through the economy. This is one example, the mobile phone, looking at how we derived the numbers to answer that first question. We found that within a linear economy, 85 per cent goes to landfill. Without any major changes to legislation or government, we could shift that to 50 per cent. Then when you look at the effect that that, together with the other four case studies, has on the bigger picture, we could see that there was a shift in that on the top graph, the demand under business as usual for resources increases and on the

lower graph the demand under circularity is actually significantly changed. So you could actually decouple growth from resource constraints through shifting towards a more circular model.

The second question: does this work for business? We studied those five subjects – in each case, the circular economy was more beneficial than the linear system. There was money to be made in each of those. I'll give you one of the examples in more detail. If you take the washing machine, if you take your current washing machine which is in most of our houses today – a relatively low-end washing machine that's designed to do 2,000 washes – that machine will cost you 27 cents a wash. It's not designed to last forever; it's designed for that linear system. The company makes money when they sell the machines. A high-end machine which is delivered and built to a much higher standard will cost that family 12 cents a wash – 12, 27, that's a big difference.

Within a circular economy, you wouldn't buy your machine upfront, you would pay per wash. That machine would be maintained by the manufacturer. So instantly, all families have access to a 12-cents-per-wash machine, but a much higher-quality machine. If that is then designed to be able to be regenerative – so you can recover the materials, you can remanufacture, you can upgrade the software – that price should come down even further, which makes more money for the manufacturer and means that we can have better machines in our houses – which ultimately costs less.

Light commercial vehicle – the same, through remanufacturing vehicles. So it's looking at recovering not just the product but the materials and components within those products and cycling them. So yes, it does work in all five cases.

Then the wider economy. We looked at the wider economy, we looked at employment. This was our employment graph. We felt that actually the circular economy would create more regional employment. There would be decreases in some areas – and this isn't a thorough, in-depth study of employment – but our overall feeling from looking at global case studies – and we interviewed 50 companies to produce this report who were already running circular economy projects – we felt that employment would increase.

Then as the bottom line: is it good for the wider economy? We worked out that it could be worth up to $630 billion per annum. This is only EU manufacturing and that's only based on cycling 25 per cent of the materials, components or products just once per year. So the figures were huge. This

isn't global, this is EU, and this was only 48.7 per cent of manufacturing. So the figures were very, very positive.

This is the technical report. The total figure is $630 billion. The report we just released, based on consumer goods: $700 billion globally, looking at those things which cycle much faster, much less than one year. Relatively speaking, fast-moving consumer goods.

What we've seen is the circular economy has taken off. When we launched, it was something that was not really heard of, but the idea worked. People are coming to us. This is about opportunity; it's about economically driven opportunity – for business, for our economy, for employment. We've been approached by companies, countries. We've been approached by people from all over the world fascinated by the idea and wanting quite frankly to unlock this economic opportunity. In developing countries there's an opportunity to leapfrog our linear system, and in developed countries we have an opportunity to unlock more growth. We've worked with the European Resource Efficiency Platform (EREP) since last summer, and we've worked with them to the extent that now in the manifesto for the EREP panel it says: 'Europe has no choice but to transition towards a resource-efficient and ultimately regenerative circular economy.' It's a goal; it's that goal to aim for. We're not there now, but it's pointing towards something that can really function.

I've just come back from the World Economic Forum two weeks ago. Last year there were no events around the circular economy, this year there were four separate events within the World Economic Forum that focused on the circular economy. It's now being picked up to a much greater extent by journalists looking at this different economic model, looking at this different way of functioning.

Just to finish, I want to show you just a few case studies of what's going on. I can talk about it and I can talk about numbers, but it always brings it to life when you can see what's happening for real.

Just on the company front, we've been approached by so many businesses, many in this space already, many who aren't in this space already. We launched last week the Circular Economy 100, which is an alliance of global businesses from all over the world who want to unlock this economic opportunity. We already have 23 companies on board and this is accelerating quickly over this year. Some of those companies already involved in this space – we have Michelin. In the US, if you're a client of Michelin and a road haulier, you don't buy the tyres – you can pay per mile. So Michelin make the

best tyres they possibly can and when they've done a certain number of miles, they take them off the truck, they remanufacture them and they go back on the truck. But they want to make the best tyres possible because that makes their margins even higher.

Caterpillar – remanufactured engines. With their big truck engines, you can actually take them into a Caterpillar factory and rather than re-bore the engine two or three times, to the point the engine can no longer function, they've designed it so there's a sleeve around the cylinder. So you remove the sleeve, put in a new sleeve and then off you go again. There's no damage to the cylinder whatever. It's been designed specifically for remanufacture.

Renault – their latest fleet of electric vehicles. You don't buy the battery, you lease it. So you get a cheap vehicle, you don't have to buy the lithium, but it allows them to be able to take those batteries back, remanufacture them. Ultimately each battery anyway would do 100,000 miles.

Ricoh – printers and photocopiers. Already designed for disassembly. They take them back into a plant in Telford in the UK, they remanufacture them. Their remanufactured printers and photocopiers sell for 70 per cent of the cost of a new one. They make significantly more profit. They have exactly the same warranty as a brand-new machine – exactly. There's no difference. They're all ultrasonically cleaned, they're all re-sprayed, the software is upgraded and they go out the door with that same warranty.

Mazuma Mobile was set up a couple years ago. They pay out £5 million a month for our old mobile phones, because those phones have value – in the phone itself, in the materials within them and also breaking them down to those bare metals. That's an industry which has grown so quickly that the mobile manufacturers and service providers are now looking at the whole system differently. O2 brought out O2 Lease, so rather than actually buying the phone you get a better tariff if you lease it. But when the next phone comes out, do we want our old phone?

But then you ask the question: would you want to lease a mobile phone? Actually it doesn't sound that exciting for a lot of people. But how about Vodafone Red Hot? Doesn't talk about leasing. Best tariff that you'll get, you get the latest technology every single year but actually you don't own the phone, it goes back to them – so it can be resold, remanufactured, repurposed and ultimately put into secondary markets.

What if the phones were redesigned so that you could recover all the materials? What if a mobile phone could go through a bath of liquids so the

materials could be recovered? Looking at the entire system, the economics start to stack up even further.

A company in Holland, rather than buying your light fittings and paying an electricity bill, they've created an office service whereby you work with Philips and you pay for a certain number of lumens at desk height. You don't buy the fitting and you don't pay the electricity, Philips do. So they build the most energy-efficient lighting that they can, because they're paying the energy bill, and then when it's time to change it for a more efficient one, they take that lighting back. Ultimately they would remanufacture that product because they own those materials. It's more efficient for the offices too.

Then Puma. The plastic bags that the shoes come in – actually at the end of the life, when you take that bag home, you can put it in water, stir it round, it disappears – you can flush it down the toilet, put it through your washing machine, whatever you want, because it's never waste. It's designed to fit in that biological cycle. So the water with that bag actually has value within it, because it has nutrients within it. So designing out waste from that system entirely allows you to rebuild that system.

So that circular economy is not just about changing the design of a product. It's not just about looking at products both biological and technical and running on renewable energy. It's about the system within which they fit, so that companies providing these products and students going through higher education can learn about how this whole system can shift to deliver us a growing economy while decoupling that from those resource constraints.

There is a question over this, and this is something I often ask myself. It's a massive challenge to redesign the global economy – huge, probably one of the biggest challenges we've ever been faced with. It's a massive opportunity but it's a big hurdle. When I think about what's possible and what's not possible, I look back to the life of my great-grandfather and what happened within his 93 years. When he was born there were 25 cars on the road in the entire world. They'd only just been invented. Now there are 700 million. When he was 15 years old, we flew for the first time in history. He remembered that, he talked to me about that. Now three times the population of the world back then fly every single year. When he was 45 years old, we created the first computer. Many said it wouldn't catch on – it was a bit big, bit cumbersome – but it did, and just 20 years later there was a microchip. There will be thousands of them in our pockets here today. Ten years later, along came the mobile phone – not that mobile by today's standards but it worked, and the

technology has come on to allow us to invest in totally different infrastructure in different countries across the world.

And perhaps the most important: as my great-grandfather left this earth, the internet arrived. If ever there is a time we can redesign the future and change our global economy, it's right now – because anyone in this room can have an idea and it can be anywhere else in the world literally within seconds. Thank you.