

Engineering Matters #205: The green, green shores of home

Podcast transcript

Host 1

The UK, and other leading economies, face a challenge: how does it grow, while at the same time cutting its impact on the environment?

Host 2

The traditional way national economies, and companies, have competed with each other is on cost. Over the last 50 years or so, companies have shifted production to lower wage regions.

That has left many industrial regions in decline. Many jobs have been lost in manufacturing industries. With that, has come social upheaval and disruption.

Host 1

And a cost-driven approach ignores—and often exacerbates—the environmental impact of manufacturing.

Cost offers only one way of understanding the efficiency of a production process, or of a national economy.

If companies and countries are to consider the environment, alongside cost, they need to be able to understand their own impacts. And when they succeed in improving their environmental performance, they need to be able to demonstrate this, and use it as a competitive advantage: after all, many consumers are now happy to pay a bit more for products, if that helps save the planet.

Host 2

But this is hard to do, if you are buying the raw materials, which contribute the majority of any product's carbon costs, from a supplier halfway around the world, in a country with poor data on how these materials were produced.

Host 1

Sam Turner is net zero champion at the High Value Manufacturing Catapult. He's been working to develop a concept the UK government, and others, can use to guide their industrial strategy, while paying attention to local jobs, green impacts, and their country's overall competitiveness.

Sam Turner

We've kind of coined greenshoring, this definition, and it started from us looking at a risk perspective. We have two challenges we saw. One is the need to decarbonize our manufacturing footprint, territorially. And second was the risk that if we, if we did that, we could potentially end up doing that by offshoring it. So how do we decarbonize but not lose the value, the economic value of manufacturing content in the UK?

I went in as an engineer expecting to find a technical solution and realised we needed some system level solutions

The major challenge is system level, around how we account for carbon through manufacturing supply chains. How do we do that in a transparent way, that's common, and standardised across sectors? How do we do it in a way that either would underpin carbon pricing or, you know, in the nearer term maybe, inform markets for voluntary adoption. So consumers, OEMS are making informed choices about the carbon content of their supply chain, which would drive a market for reducing carbon content and will start to reward manufacturers who make investments to reduce carbon content.

If offshoring has been the placing of manufacturing content in low cost regions of the world. Greenshoring is placing manufacturing content in low carbon regions of the world.

Host 1

Welcome to Engineering Matters. I'm HOST 1, and I'm HOST 2. In this episode we've partnered with the High Value Manufacturing Catapult—one of a network of independent, not-for-profit organisations that bridge the gap between research and industry in the UK—to learn about the work they've been doing to help the country's manufacturers compete in terms of their carbon impact.

Host 2

It's an idea whose time has very much come. The UK's manufacturing performance has long fallen below its research performance. And the events of recent years have demonstrated that the country can't rely entirely on globalisation.

Sam Turner

We're, by various measures, top three in the world in terms of academic output, and we're not at that level in terms of industrial output.

Katherine Bennett

The skills that the UK has in design, design for manufacturing. And I think it's something that we possibly don't talk about enough, about where the UK really has your crown jewels, the key skills, and if you're good at the design, you would then hope that it makes a better case for the manufacturing to also be done here. And I think in the past, maybe that's reduced, hasn't it? We're good at the design and then it goes offshore.

Sam Turner

We're in an environment now, after COVID, Brexit and Ukraine conflict, where there's more sympathy, for looking at, 'How do we build that UK, competitive, supply base that provides resilience, provides wealth'. And actually could be a big answer to how we decarbonize not only our footprint, but start to decarbonize the wider footprint and lead industrial decarbonisation globally.

Host 1

As a consumer, or an investor, it can be hard to identify how your spending choices can help the world reach Net Zero. Often, a few clever ideas come to prominence, but have little real impact.

Sam Turner

if you look at all the claims around low/zero-carbon products, we've already fixed the global warming problem and you know, it's not... We're a long way from doing that. So there's still room for greenwashing, either unintentionally or intentionally, at the moment. So clarity and transparency is really important. If you have that transparency, then you can think about, or if that data is available, that's available to investors, who could then ask and say, 'Well, where are these standards? Give me the evidence base of what the plan is, the current footprint is, for this product, for this supply chain, or the plan to get it done zero carbon?', so it starts to incentivize finding the right places.

Host 2

To have the biggest impact, we need to focus not so much on outwardly green solutions, but at the roots of the economy.

Sam Turner

It's easy to put green money into an offshore wind farm or a product that is overtly addressing Net Zero solutions, end use case solutions. Whereas things like steel and foundations industries are seen as dirty, we don't invest in those, whereas that's where the money is required, right? Transformation of the current high emitting sectors is where green finance is required. And because we don't have the subtlety, I suppose in reporting and standards and transparency, that... it's easier to, it's safe to say 'We'll put our green money into green products,' which are new markets, right, but we've got to decarbonize the existing manufacturing base, so the standards would, and transparency would, help, to channel money, into those investments, to drive the changes we've been talking about. But equally they would underpin carbon accounting and carbon pricing at a regulatory level or carbon border tariffs and they would underpin voluntary market adoption.

Host 1

To get to the roots of the problem, we need to identify where carbon costs are coming from. Typically, this doesn't lie in an individual product's design or features, but in the materials they are made from

Sam Turner

A study we've done as the catapult demonstrated that between 60 and 95% of the embodied emissions in manufactured goods, in the sectors we looked at—we looked at the automotive, aerospace, electronics sector - we found that 60 to 95% of the embodied emissions were in the raw materials processing steps, so not in the downstream manufacturing activities.

We work closely with the aerospace sector, for example, some great work being done to decarbonize the OEM and Tier 1 assembly facilities. That's scratching at five to 15% of the problem. The real problem lies in the material sourcing, which generally comes from overseas. So bringing that material sourcing here, looking at clusters where we actually think

about material production alongside the mid tier manufacturers who are processing that, alongside those OEMs, who actually need to assemble those, is the value we're trying to bring.

Host 2

The High Value Manufacturing Catapult is ideally placed to help companies—and the country's political leadership—identify ways to cut these costs.

Katherine Bennett is CEO.

Katherine Bennett

The reason for a catapult existing is to what we call de-risk innovation.

About 12, 13 years ago, the government at the time, were looking clearly at industrial strategy, it was a buzzword then. And they ordered a number of review reviews and Hermann Hauser, for example, was asked to do a review.

This resulted as a result of pressure from companies too, which I think is absolutely key, about, hopefully, why all the Catapults are turning into being a success over the decade they've been in existence. So it wasn't just somebody in Whitehall thinking, let's do this, or even a company, pressurising in isolation, it was a combination of the two

Part of the review work that was done at the time, of course, was to look at what's done in other international settings. And Fraunhofer Institute was a good example of a system that they saw working very well.

Host 1

The Catapult Network was set up a decade ago, and was shaped in part by work done by local authorities and development agencies to identify existing local business, and research, clusters.

Katherine Bennett

My Catapult is made up of seven centres, some of whom have actually been around a lot longer than the word Catapult existed in terms of talking about innovation. So Warwick Manufacturing Group as part of Warwick University was established 30 years ago. And then there's also the AMRC, at the University of Sheffield in Rotherham. That's just celebrated 20 years. So what happened was that the government did encourage these different centres to actually get together.

Then there's other centres such as MTC that were only created 10 years ago. And that wasn't done directly with one university. It was actually a number of universities and also large companies in Coventry, who really could see a need for collaborative working. So lots and lots of different contexts and history.

Host 2

The Catapults' links with both business and the research community allows them to spot clever ideas, when they first appear on the horizon/.

Katherine Bennett

Well, the big thing for us, of course, is foresighting future technology. And whenever I say to people where I'm working now they're like, "What's the big thing that you're working on?". And it's quite hard in a sector as large as manufacturing, because there's so many different facets to it, which I've found fascinating since I've been in this role.

Host 1

It lets them see connections between the work of different researchers, who are often as competitive—if not more so—than businesses.

Katherine Bennett

Universities are extremely competitive. So it's not all a bed of roses. And the most important thing is, what academics do love working on, is helping solve problems together. They may say, oh, no, I'm far more expert in that area than you are. But that's part of the academic thrill, I guess, the competition.

Where we are, is more in what it actually tangentially means for business, you know, the idea? How can they turn that into reality in terms of manufacturing a prototype into commercial reality?

Host 2

And it is able to help academic researchers, and R&D teams in the private sector, make the most efficient use of national testing facilities.

Katherine Bennett

This is particularly part of where we've been evolving over the last 10 years is, for example, we wouldn't want what they call a carbon fibre weaving machine replicated, it's a very expensive item of equipment to buy in one place that, you know, could be used in the similar technology and capability is actually needed elsewhere, but you wouldn't necessarily buy a second one.

One of the other aspects that we bring is the convening power. Maybe this is again, an expression often used. but you think about those three and a half thousand people that we directly employ, working with their partners respectively, and of course, the regional approach, and the regional spread they have. And then add to that, the university connections—and by the way, our university connections and not just what we call our sort of home anchor universities. there's a huge number of other academic institutions we work with.

Host 2

This has had a real world effect, helping businesses shape themselves around new technologies, and new demands from consumers for more environmentally efficient goods.

Katherine Bennett

We've been around for 11 years, and it's still evolving in terms of what we're contributing and there's some incredible statistics of things we've done over those 11 years, we've worked with nearly 26,000 companies.

One example, which is, you know, still in in our hearts and minds is the work that the catapult did, and I'm sure you've heard about this, during the COVID, in terms of the ventilator challenge, and that was a great example of getting companies together and our different centres across several sites. Absolutely laser-focused on how they can help the nation design—or not design, because they're using an existing product—but how they could ramp up production of these ventilators.

Another example I could give you is work that AMRC and Rotherham have done on a project with a company called The Ultimate Battery Company, which was all about electric vehicles, and that was as a result of a company coming up with an innovation, but they really, really needed the academic help. And we were able to convene with with AMRC, and the University of Sheffield and some other partners, get all the great minds together.

They've created 500 new jobs on this project. And actually, they've set up a facility alongside AMRC. So that's a good example of an innovation coming to reality.

Host 1

Russ Hall is the HVMC's chief engineer for Net Zero. He's also the lead for Sustainable Manufacturing and Circular Economy at WMG, the Warwick Manufacturing Group.

His academic background is in metallurgy, and that led him to work with Frog Bikes, a UK manufacturer that has been working to improve the environmental impact of its products.

Russell Hall

March, April time last year, I became involved in a project called the UK Bike Valley and UK Bike Valley, it's actually a great example of where we're trying to Greenshore industry. So UK Bike Valley, the sole aim of it is to look at the reinvigoration of bicycle manufacture in the UK. And that's being organised by the UK Bicycle Association. And as part of that, I came across Frog Bikes.

Frog Bikes are really interested in looking at how they could manufacture their products more sustainably.

Host 2

Frog Bikes was born ten years ago, not long after HVM Catapult. But while HVM Catapult is focussed on the economy as a whole, Frog, like many of the most successful businesses, identified and a specific gap in the market, and went about filling it.

Shelley and Jerry Lawson were the founders of the company, and their idea for it came directly from their own experience as parents.

Shelley Lawson

The idea came to us when our own children were quite young, and learning to ride bikes, and we were surprised by how heavy and how badly designed most kids' bikes were. And really, nothing had moved on since we learned to ride in the 70s. So we felt there was an opportunity for much lighter bikes for children. To enjoy cycling more, and for them to be better designed specifically for children.

We have a really wide range of children's bikes from three sizes of balanced bike—so really from the age of about 18 months to 24 months upwards—right the way through your first pedal bike. through what we call hybrids, which are fairly good multi purpose range of bikes, and then some specialists as well, so city bikes, road bikes, mountain bikes, and even track bikes for velodromes so we've got a really comprehensive range, of very lightweight aluminium frame and fork bikes, and we sell them in 30 or 40 countries, depending on when you're counting around the world, in about four continents around the world.

And we sell them almost exclusively through independent bike stores, where parents get really good service, the child will get measured properly for a bike, and the bikes are built and maintained to last as long as possible.

Host 1

That local approach to production, and to distribution, has played a big role in Frog's environmental, as well as business, successes. By focusing on 'servitisation', designing products to be used for longer, often under an ongoing contract rather than a single sale, companies can both build a connection with customers and distributors, and reduce the carbon footprint of products, for each year of their life.

But the environment wasn't the initial focus of Frog's strategy. Instead, they realised that they needed to account for their environmental impacts, as they built their business.

Shelley Lawson

We didn't really start by feeling it was going to be a source of competitive advantage. We started on a more personal level, feeling that as we were getting bigger as a manufacturer, we became increasingly aware of the carbon footprint we were causing, especially by using aluminium, because virgin aluminium unfortunately has a very high carbon footprint, very high emissions. So as we grew, this became more and more important to us to try and do something about it.

Shelley used the Greenhouse Gas Protocols to help her think about the business's impacts. Scope 1 of the protocols considers an organisation's own impacts; Scope 2, the impacts of the energy sources it uses; and Scope 3, the impact of its supply chain.

Shelley Lawson

We looked first at the kind of the low hanging fruit, which for most companies is probably what's known as scope two. So the emissions from the power that you buy. We're lucky enough we don't we don't have any furnaces or any big plant of our own. So we've got no Scope One emissions, but Scope Two was substantial enough for us—because we run two

sites in the UK, and you've got to light them and heat them and power all the equipment and so on—so we looked quite hard at that.

And we had to lobby our landlords in both sites and it took several years to persuade them to buy all the power for both sites from renewable sources rather than the old fashioned fossil fuels. But once they did that, that was great, because every tenant on both sites has now got renewable power. And that reduced our emissions to some extent, nowhere near as much as we need to for what's embedded in the aluminium.

Host 1

And it was looking at its raw materials—essentially, aluminium tubes for the bike body, along with some steel for other parts like spokes—that showed Shelley how much of Frog's environmental impacts fell under Scope 3.

Shelley Lawson

When we started footprinting our emissions, it was obvious that the aluminium was the real hotspot for us.

90% plus of our emissions come from the aluminium. So that was where we needed to focus our attention on. Firstly, can we make a really strong bike with a bit less aluminium? And secondly, where can we get the aluminium from which is not as highly emitting?

Host 2

One way to address these impacts was to reduce the amount of metal used in Frog's bikes. And as they are already focused on making their bikes as lightweight as possible for their young users, this was something that they were well placed to address. It was just one more factor in their overall design strategy, and they could do it without adding cost.

Shelley Lawson

Almost everything that we've done has either been very similar in price, or in some cases, has actually saved money. So if we talk a little bit about the design of the bikes, we looked—well we tasked our r&d team to look at—whether they could make an equally robust bike, using less material. And they started by looking, for example, at the spoke pattern in a wheel and re-lacing it in an, in a novel way. And they've managed to take 10 to 12 spokes out of all of our wheels and they are just as strong.

It's better for the child because it's lighter. It's better for us because it's cheaper and quicker to build. And it's better for the planet because you're using less material.

Jerry Lawson

We've also lowered parts of the bike, which means there's less aluminium used in the bike and the frame and the fork, which has taken weight out. Now, that's our ultimate goal. But because we're using less aluminium, then it does mean there's less impact on the environment. So slowly we can chip away at some of the things we're doing to improve the environmental impact that our bikes have.

Host 1

The structure of Frog's distribution network, as much as the design of its bikes, has also helped it reduce the impact of its use of virgin materials.

Shelley Lawson

It's also important that each bike is used for as long as possible. So you, so we're, not continually digging more stuff out of the ground to make yet another bike. So we build the bikes very, very robustly so they last a long time. But we also encourage people to either sell them or pass them on when their children have outgrown.

Host 2

Bike shops struggle to make a business out of second-hand sales. So Frog has set up an MOT scheme—similar to the scheme for certifying the roadworthiness of cars—for used bikes. That incentivises the stores to support the circular economy, and gives Frog valuable insights into the performance of their products.

Shelley Lawson

They do a kind of MOT on it. They can change any bits that are beginning to wear, they can report back to us any bits that are beginning to wear over time, because in the past we'd have sold a bike and never seen it again. Now we're starting to see what bikes that are 5, 7, 8 years old are looking like so that's great to feed back into our R&D.

Jerry Lawson

The launch of our MOT scheme, is about helping the stores even if they haven't sold the second hand. They're getting a customer who's—down the road—who's picked up a second-hand bike, beginning to build that relationship. So this is about us supporting them again.

Host 1

But there is only so much Jerry and Shelley can do within their own business. As they look to source components and materials from more environmentally sustainable suppliers, it becomes extremely hard to get the evidence they need.

Shelley Lawson

The quick changes—the Scope Two—there's some excellent free tools for that, it's really easy to plug in what you what your energy bills are, how many kilowatt hours you've bought in the last year, and maybe how many miles you've driven, and it spits out your your emissions. That's good, reliable data that anybody can easily access.

But for a manufacturer like us, of course, all of the emissions are scope three and there's, there's nothing I found that does a thorough enough job for our particular supply chain: and ours is no more complicated than anybody else's. But we needed something that would help us find the emissions from aluminium that we sourced from a particular part of the world, coupled with the logistics that get you from one part of the world to another. That data is sort of publicly available if you go digging—so people like the Aluminium Federation were great at pointing me in the direction of some general emissions data.

But at the moment, there's nothing that's 100% accurate.

Host 2

Frog have been working towards making their bikes from recycled materials, and have already tested a model using 25% post-consumer materials. But with materials—whether virgin or recycled—coming from around the world, it is impossible for them to accurately gauge their successes.

Shelley Lawson

When we talk about Greenshoring, there's a couple of big—well there's a number of big benefits from it. One is that, not only would we have more control over the mixture of aluminium, and it will be easier to audit exactly what that material is, and trace it through the supply chain, if the supply chain is shorter. But also if it's made closer to home and basically outside Asia, the energy mix is much more towards renewables.

But very long term, we've said we will get to net zero by 2050. We can't do that without properly closing the loop on our supply chain. So that means when a bike has finally changed hands a number of times and been mended and repaired and patched up, it gets to the end of its commercial life, we will have to find a way to take that bike frame back, and use the aluminium again. And we can't do that if our supply chain is spread out across the world. It will have to be close to where our main operations are.

Host 1

But, as Russ explains, the UK is currently not able to supply the materials manufacturers like Frog needs.

Russell Hall

In the UK, there isn't a huge amount of primary aluminium manufacturer. So it's very difficult for a company like frog to know when they're buying their aluminium, what the actual environmental footprint of the aluminium is. So at the moment, they buy their aluminium from China, and they don't know when they're buying it from China and what the actual co2 output—if we're just talking about co2—is so it's very difficult for them to find out. And for them to do so they have to go through intermediaries, they have to ask for certificates. There's no way of guaranteeing that that data is correct.

Host 2

Even without considering the environment, there are clear benefits to business resilience of local sourcing.

Russell Hall

Well partly the demand is for sustainability, but also partly that it minimises the risk for UK manufacturing. So if all of your foundation material was to be outsourced, so, foundation industries—concrete, metals, paper, chemicals—if all of that were to be outsourced to other countries, for whatever the reason is, whether there is an environmental argument or a cost argument it puts the UK manufacturing sector at great risk, because they have to rely on imports.

Host 1

To draw in the investment needed to supply materials like these, will need the UK to make a clear business case for building these facilities.

Russell Hall

The first thing we need to know is that there is a market for it. And that market can't be an individual manufacturing market, so it couldn't just be bicycles.

Firstly, if you look at something like metal manufacture, for steel or aluminium, what you need to know is that there is a requirement for an amount of material, that could support the development of something like an aluminium smelting plant. So we're not talking a few tonnes, we need to be talking thousands of tonnes or tens of thousands of tonnes, in order to make what is a significant investment worthwhile.

Host 2

Making those arguments for investment must consider the different interests of the country as a whole, and the interests of individual businesses.

Russell Hall

The government's interested in job creation, they're interested in skills creation, they're interested in GVA, so they want to know what the Gross Value Added is going to be for the UK. Is it worthwhile supporting it? And it's a really good question, is it worthwhile supporting it? Why should they put taxpayers money into things that aren't going to achieve anything for the UK? It's a very good question.

It's a slightly different question if you're a manufacturer. So you want to know that there is a market you can sell into, that is going to be profitable, and also that's going to be sustainable. So that's environmental sustainability. And knowing that your business, if you start it, is still going to be here in 10 years. It's never good starting something that's going to die after a few days.

Host 1

The time scales raw materials suppliers use to plan their investments, and the buying cycles their customers work to, are very different.

Russell Hall

I was invited to an Australian trade delegation for critical materials last year. And if you mentioned on one side of the table, there were a bunch of guys who owned mines, and they wanted to develop mines for materials to go into batteries. And on the other side of the table, were people who owned automotive companies, or worked for motor companies. And the miners called out straight away that the types of investment they were looking at, were not the same as the buying cycles for the automotive companies.

If you want to run a mine, actually what you're looking for is 10, 20 years worth of investment. What we don't want is three years of negotiation about who's going to give you

the cheapest product. So there has to be something that acts in the middle, or some way of translating the demands from one to another.

Host 1

The Catapult can help bridge some of these gaps. They can talk to both suppliers and OEMs. And they can take what they learn from both, to government, and to the research community.

Katherine Bennett

There's things that we at the Catapult can say that maybe a business can't say, because there's always other aspects, their own shareholders, etc., but we can say, 'Look, we're hearing this from business, we need to get the circular economy going, we need to be looking at use of raw materials, we need to be getting energy prices down'.

Host 2

The Catapult can also help all of these parties make their needs—and challenges—known to standards bodies. And Sam believes that standards-based systems for carbon accounting will be at the centre of allowing businesses to compete in terms of environmental efficiency.

Sam Turner

We've been working with BSI—as the High Value Manufacturing Catapult, and with some of our other catapult colleagues energy systems and often renewable energy and digital digital catapult as well—But working with BSI to survey the standards landscape and interview key industry stakeholders as to where they think the problems lie, you know, what do they need for transparent carbon accounting, to make the right choices, to make the right design choices, to make the right supply chain choices?

So we've been conducting a review of a number of sectors, and that's... um... the outputs of that assessment are, are being used to, kind of, set practical requirements for those standards. And then we're, we're using that to go and review what's out there in terms of current standards. So there's not a shortage, there's just a lack of clarity and adoption. And maybe there are some gaps and we're reviewing that currently. Do we need new standards?

Russell Hall

Is there going to be a single standard that will tell you how to do it? There will be hopefully, I would hope, my my 'grand vision', is that one day we would have a single portal that you could go to and you would enter the type of... the type of industry you're in, the type of company you are, the size of company, your position in the supply chain, and it would give you a framework that you then followed for how you did your carbon accounting or your emissions or your sustainability accounting.

If we can do that foundation work of how you measure it, it will probably show us why greenwashing things is really important.

Host 1

The UK's move away from local manufacturing, was mirrored by a move into services, and particularly into financial services and technology. That may now set the country up to play a leading role in tracking environmental performance.

Sam Turner

There are some real strengths there, that the UK has in the tech sector as a whole. And you think about you know, fintech,

You could turn some of that world-leading skill base towards this challenge.

There are opportunities for things like blockchain here, or distributed ledger technologies, to be more precise, you know. One option, for reporting carbon content, is every company reports their carbon, their Scope One and Two content and you pass it down a blockchain.

Because everybody's scope three, is someone else's scope one and scope two

You could have a hybrid system, where you've got, kind of, a lookup table with averages for a region and a sector, for the black spots; and you've got actual data, where companies, in the supply chain, have reported. And, you know, you could put weightings and incentives on the way you report that data. So you know, a higher trust weighting, rating, on a report that has actual reported data, versus, you know, 'database data'.

Host 2

Developing systems like this will bring business to the City of London, as well as enabling manufacturers around the country to compete on carbon content.

Sam Turner

In the future, global markets will price-in embodied carbon. There's going to be a huge carbon accounting sector. Huge opportunity for consultancies, for conventional financial accounting firms, for the tech firms developing the blockchain, the data analytics, and reporting systems. So it's going to be a hugely vibrant and innovative sector at some point. So it's another area for us, where we're interested in looking at, 'What can you develop in the UK? Where can we support UK companies in providing some of those solutions?' And then we'd like to test and pilot those.

Host 1

And much of the Catapult's work looks at the impact on the country's regions. This allows it to form partnerships with local leaders, who are perhaps better able to represent the needs of business.

Katherine Bennett

We have particularly strong links with Andy Street in the West Midlands—he's an extremely strong supporter of our two centres there in the West Midlands, Warwick Manufacturing Group and MTC—and he is happy to shout from the rooftops about innovation and how it can help his area.

Andy Burnham equally, we're doing a lot of work now in Manchester, we recently announced we had agreed an MOU with Greater Manchester Authority with one of our centres, CPI. There's a huge area there, in Rochdale, that they've got real opportunities, they want to get partnership working.

Host 2

But this will also take national leadership, Sam says.

Sam Turner

We've got to not only look at the opportunities that Net Zero brings in terms of creating the next wave of offshore wind farms, small modular reactors for nuclear, decarbonized transport, be that automotive, aerospace, but also looking at how we decarbonize the supply base that we have, that supply base is low is low, low carbon, coupled with design authority and ownership. So the r&d and design is really important.

So government can incentivize building those design skills and competencies, incentivise businesses to either grow in the UK or come place themselves here, where they will put their, head office, their design authority here, and start to have the benefit of access to low carbon supply chain clusters, that we invest in the infrastructure, that can clearly report and account and demonstrate their low carbon content and value.

[End music]

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