Engineer Progress: The road to net zero

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How do we unlock net zero innovation?

In this series of roundtable gatherings and reports, Tharsus has been aiming to gain an understanding of how the manufacturing industry can unlock innovation and engineer progress for the UK.

In our first report, we looked at the barriers facing innovators in spinning out innovation, scaling, and securing valuable IP – and what can be done to overcome these.

The main factors that could drive success in each of these areas, we discovered, were the power of having a clear purpose – innovations must deliver positive impact – and effective collaboration, particularly between organisations who would not usually consider working together.

Applied to the global challenge that require the greatest innovation – climate change – this counts double. It is, quite simply, the defining threat facing our planet, and any innovation that is developed without a view on its potential environmental impact, will not be fit for purpose.

Attempting to overcome this challenge will require collaboration between every country on Earth, as has been proved at COP26 in Glasgow in November 2021, where there has been a conscious transition from governments in allowing companies to drive their own sustainability agendas, to pledging and policymaking to hit global green targets.

The reality is setting in for businesses and governments that if we do not act now, the global net zero target for 2050 will not be achieved. Reaching net-zero emissions requires extensive changes across the economy and within all major infrastructures. In some cases, it will require a total transformation.

Now is the time these transformations must take place. And with manufacturing a significant contributor to carbon emissions – 880 million tonnes of CO2 emissions come from European manufacturing alone – the sector must be at the heart of the drive to net zero.

In a roundtable discussion held in the lead up to COP26, leaders from the manufacturing industry came together to discuss the key trends that will drive innovation to net zero.

“Now is the time these transformations must take place.”

Shifting mindsets

Efforts towards achieving net zero must begin with a shift in perceptions. The green transition has historically been viewed more negatively than necessary due to a common belief – and to some extent, truth – that the implementation of sustainable initiatives will carry a high cost.

Transition is not as simple as a snap of the fingers. Changes needed within the industry are extensive and demanding. Solutions such as electrification and renewable energy create a higher carbon footprint initially and are expensive to set up.

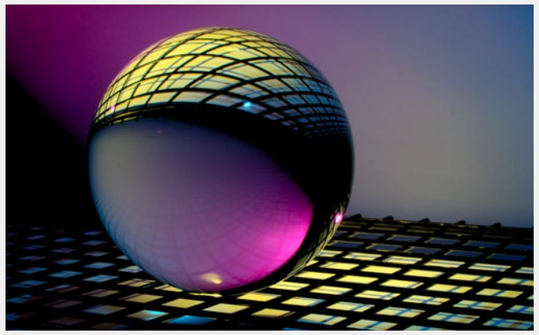
In tangible terms, there needs to be resource efficiency, electrification of transport and heating, the development of a hydrogen economy for industrial processes, and carbon capture and storage. These operational transitions are large-scale and daunting to many organisations – particularly smaller businesses with fewer resources, who simply do not know where to start, and have day-to-day business operational priorities to contend with.

But the benefits of green transition far outweigh the initial costs. Sustainability is a real opportunity for business growth and development. In terms of competitive advantage alone, if consumer trends continue moving towards a demand for more sustainably-sourced and produced products, those whose output has a negative impact on the environment will simply fall behind.

A change to more sustainable global infrastructure will also provide multiple new opportunities for digital technology, particularly for the use of AI – a technology that could reportedly help to achieve 79% of the Sustainable Development Goals. Amongst many other use cases, AI can also help with traffic management to reduce pollution, enhancing the efficiency of renewable energies and improving industrial processes through highly accurate error prediction.

These decarbonising technologies will also open new doors for opportunities in employment. Not only do we need the people to innovate and create this technology, but also people to organise sustainable strategy and implement them business-wide. Transforming the industry will thus create a new, larger pool of talent for companies to draw from.

Young people are one of the major driving forces of climate change resistance and since they are more likely to make employment decisions based on ethical values, they will be attracted to companies with sustainable strategies. In return, these businesses will have a wider selection of forward-thinking talent with fresh perspectives and digital skills.



Taking responsibility

The industry carries a significant influence over the potential of achieving net zero, which is why companies must start paying attention to their responsibility.

Volkswagen is a key example of how companies can make a difference, and how to use their influence for good. It identified that significant carbon dioxide improvements could be achieved through an alteration in the production of battery cells in its supply chain, agreeing with its supplier, LG Chem, that only certified green electricity will be used in its battery production in Poland. By demanding green power in this way, the company successful put pressure on the Polish government to develop and provide renewable energy across the country.

At a grassroots level, individual consumers can have an impact on climate change through their buying behaviours and ethical values. By making deliberately sustainable choices in their shopping, such as purchasing reusable coffee cups or taking fewer long-haul flights, consumers can reduce the demand for carbon-intensive activities. Companies, reliant on their consumers, will in turn adapt to meet these demands.

But the responsibility should not be placed purely on the shoulders of consumers, who will always consider cost and convenience as factors as well. For industry-level change, responsibility lies at all levels of the supply chain.

Companies must be the driver of sustainable consumption themselves and pro-actively change their production methods and ensure the decarbonisation of their supply chains – as exemplified by Volkswagen in Poland and others – so that sustainability is not a choice consumers have to make, but the default.

Going beyond strategy

To complete the steps necessary for greener supply chain operations, companies need first and foremost to strategize. Creating a clear roadmap as to how net zero can be achieved, what must happen, and when it must happen by, is the only way to meet the fast-approaching deadline.

Setting green goals is no longer good enough, it is now essential they are fulfilled. Currently, even if a company is publicly stating that they are looking to create green supply chains, they are not legally bound to follow their words with action. Thus, many of the companies advertising green targets, do not have the data to support their claims, and will not meet the 2050 net zero timeline.

There is evidently a need to hold companies to account for their targets, which is possible through road mapping. If the promise of net zero is to be achieved, and not simply remain empty words, it needs to be transparent how companies are working towards it.

Climate activist Greta Thunberg described the COP26 global leader discussions as ‘blah, blah, blah’, arguing that while there is a lot of conversation about sustainability, and individuals are certainly transitioning, for all the talk around net zero – action has not been systemic. There is still so much progress to be made and with the clock ticking, although conversation can help to form strategy, it is infrastructural change that needs to be happening, and happening now.

Within manufacturing, net zero must be achieved through operations, with guides to sustainability focusing on avoiding future carbon emissions by designing and making decisions differently, reducing greenhouse gases by shifting to renewables, investing in removing carbon across the value chain, and innovating in green technology.

The pathway is there. The ideas are there. All that is left is the execution.

To answer the question of how we achieve this, we will be speaking to a number of experts in sustainable manufacturing, to understand the barriers and how we cut the key that will unlock net zero innovation.

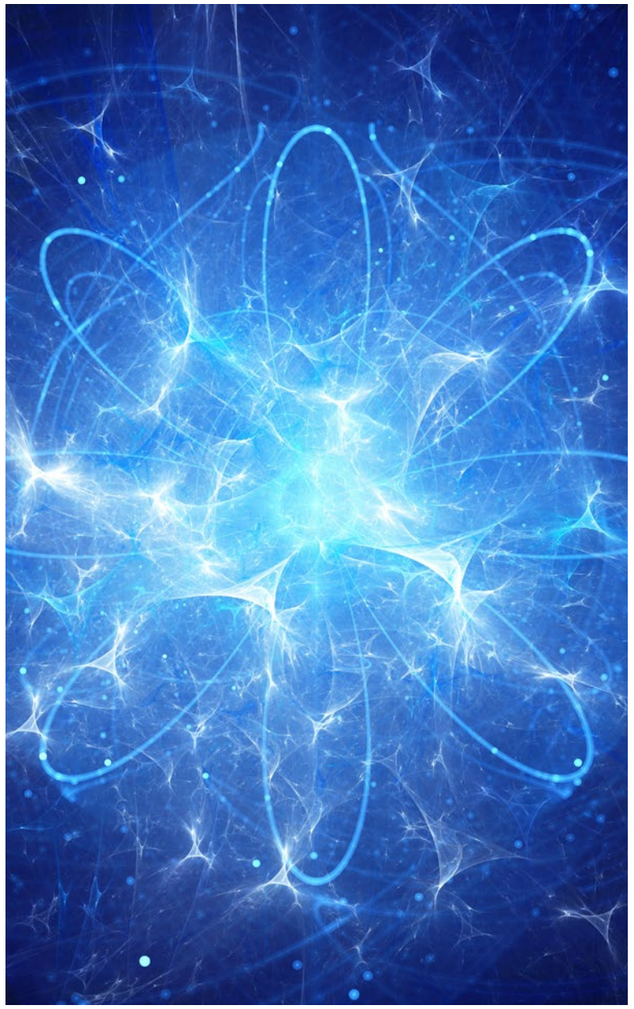
Is the UK ready for a new generation of nuclear energy?

Andrew Storer
CEO, Nuclear AMRC

Nuclear power currently generates close to 20% of our electricity and 40% of our clean energy, making it a driving force behind the race to net zero emissions. And this is something I believe the country must wake up to.

However, big decisions need to be made regarding the future of nuclear energy. The UK's fleet of AGR power plants, which have been reliably generating low-carbon power since the 1970s and '80s, are all set to be decommissioned this decade. We are now losing reliable low-carbon generation capacity just when we need it most.

To generate enough clean energy for the future, our plans must go much further than just replacing these decommissioned plants. The latest reports from the IPCC emphasise the urgent need to decarbonise our energy system by deploying a host of technologies, and it is increasingly clear that nuclear must play a significant role.



Recent crises in the energy market have also highlighted the importance of moving away from imported fossil fuels towards secure, sustainable and affordable alternatives. If we want to make real progress towards net zero emissions, we need to produce much more nuclear energy than we currently do.

If you look at the electricity requirements for Britain and for the world, we must ask: how many gigawatts (GW), how many nuclear power stations, how many wind farms, and how many other forms of energy production do we need to sustain that? When you start to look at today's electricity demands and that of the next generation, it is intimidating the amount of power that will be required, especially if we want it to be clean.

In this context, new targets for nuclear capacity in the recent British energy security strategy are a welcome step in the right direction and should help get us back on track.

The new target of 24GW by 2050, up to 25 per cent of total generation, should be a minimum baseline. We can go further with nuclear to provide a truly sustainable and secure energy mix. Modelling by the Energy Systems Catapult has shown that the optimal pathway to net-zero includes up to 50 per cent of nuclear by 2050 – potentially up to 40GW of capacity.

The simple fact is that nuclear remains the only source of proven, reliable low-carbon power generation that operates around the clock, whatever the weather. As an energy source in and of itself, it is also statistically the safest, seeing 330 times fewer deaths than from coal, 250 times less than oil and 38 times fewer than gas – and, of course, it helps avoid the catastrophic costs of unchecked climate change.

"The simple fact is that nuclear remains the only source of proven, reliable low-carbon power generation that operates around the clock..."

It is also a far more easily scalable power source than variable renewables, which incur a rapidly increasing cost in grid stabilisation, energy storage and back-up technologies as their share of the energy mix increases. But this narrative has never fully taken hold outside the sector itself.

The UK nuclear new build programme has struggled to get moving over the past decade, but the barriers have not been technological. They have come from the costs and risks of securing upfront financing for these multi-billion-pound long-term infrastructure projects. The Regulated Asset Base (RAB) financing model, which has now passed into UK law, should reduce those barriers and unblock major projects such as Sizewell C. A financial commitment from government, and the introduction of more easily financed small modular reactors, should also make nuclear a much more attractive place for institutional investors.

An intensive nuclear build programme will stretch the capabilities and capacity of the UK supply chain, but industry is ready to step up.

The Nuclear Advanced Manufacturing Research Centre (Nuclear AMRC), part of the national High Value Manufacturing Catapult, has a significant role to play here. We are a UK leader in helping manufacturers to win new work contracts across the nuclear sector in new build, operations and decommissioning. Our role is to work with industry, academia and government to accelerate and encourage the progress of nuclear power in this country.

We have worked with hundreds of UK manufacturers to help them prepare for the opportunities and needs of nuclear projects, and are working with developers to make sure that new reactor technologies can be manufactured in the most cost-effective way.

Our Fit For Nuclear (F4N) programme helps manufacturers enter the nuclear supply chain and win work. We match the nuclear supply chain to opportunities, and then ensure suppliers are ready to deliver in terms of systems of process, manufacturing and the best cost reduction possible. Over the last decade, companies we have worked with through F4N and other supply chain programmes have won some £2 billion in new contracts. And there is potential for so much more.

New nuclear power can also bring the biggest economic benefits to the UK of any energy technology, which will be felt nationwide: around 90 per cent of jobs in the industry are based outside London and the South East, and the average value of jobs in nuclear is around twice the national average.

If we do not make the necessary plans to increase our nuclear capabilities, there is no clear roadmap to reach net zero by 2050. But if we embrace nuclear and accelerate its growth across the UK, then we can lead the world in demonstrating the safe and clean value of nuclear energy.

“An intensive nuclear build programme will stretch the capabilities and capacity of the UK supply chain, but industry is ready to step up.”

Why sustainable supply chains are key to a net zero future

Veera Johnson
CEO, Circulor

The key to being an environmentally sustainable business is to start by looking at the fundamentals of your industry. Within manufacturing, it has become very common in the modern era for companies to outsource their manufacturing and raw materials supply chain, because it is often cheaper and easier. This might be viewed as a positive benefit on the surface by a company in terms of their short-term profit margins, but what we are faced with as a result, is businesses that have very little visibility into their own supply chain.

This can cause a whole range of ethical problems that can see a business that preaches sustainability indirectly doing more harm than good. And so, it is important for organisations to have contact with all stages of their supply chain, and an ethical code of conduct with criteria that all their suppliers must match.

Questions all businesses must ask include: where do my materials come from? Is the supply chain as environmentally friendly as possible? Were any human rights infringed in the collection of these raw materials?

Furthermore, if you do not have the correct ethical answers to these questions, you have to then start thinking about whether you switch suppliers, or play a part in tackling a deeper issue in the overall ecosystem of manufacturing.

Aside from external influences insisting on companies implementing more ethical and environmentally friendly business practices, we are now seeing investors and other stakeholders demanding that the organisations they are involved with undergo these checks and move towards a more sustainable process.

It is positive to see that although there may be some financial cost or burden in the short-term to changing your business practices or to have a full appraisal of your supply chain, investors are waking up to the fact that not only is it a business' moral obligation to be more environmentally and socially friendly; but to be successful in the future and attract more investors, they must have a sustainable business model.

Put simply, going green makes good business sense, as well as being an ethical prerogative.

Circulor's mission is to help prevent the exploitation of people and the planet. When we work with a company, we help them to put together and track an overall macro-scale carbon footprint, by taking into account a range of different factors. We investigate deeply into their supply chains, tracking and evaluating everything from carbon emissions, to waste management, to their employees' travel, impact on local wildlife, the footprint of their contractors / suppliers, to the impact of the initial construction of a company building itself.

Businesses must also consider local and global socio-economic factors, such as job opportunities or displacement and the impact their company may be having on an area socially; be it local to the company or another geography on their supply chain.

To begin to initiate change, we often try to give guidelines to businesses on what makes good practice and what does not, helping them to create more detailed records of the different steps in their supply chain. We mainly use data collection technology to provide complex analysis to help companies see all the facts of their supply chain and figure out the balance between their issues and making positive changes, such as how they can make these changes in a way that does not massively impact their consumer demands.

I would like to see the Government play their part by providing these kinds of basic guidelines and reviews for every business. Interestingly, a lot of this information is stored already by companies and governments regarding supply chains, environmental and socio-economic data; but they choose to withhold it or use it competitively.

I want to see us move towards more of a cooperative situation where everyone has the same mission of reducing exploitation of people and the planet. Furthermore, if some companies are going to choose not to share this kind of data, there must be some kind of understanding that they will make the right decisions off the back of it.

As part of the advisory board for the Digital Supply Chain Innovation Hub and as an ambassador for our mission at Circulor, I hope we can bring companies of all sizes on board for the goal of creating more sustainable business and working in collaboration to have the most ethical and rational supply chains possible.

Why sustainability is an argument of efficiency

Professor Tim Minshall
Dr John C Taylor Professor of Innovation & Head of the Institute for Manufacturing, University of Cambridge

Climate change is a complex systems problem that goes beyond any single political or commercial cycle. Unaccepting of national boundaries or politicians' term limits, addressing it to its full extent must be a collaboration across borders and political alignments. COP26 in November saw perhaps more progress than ever before in terms of the international conversation. But when it came to action, it was not enough.

What we need is a global coalition of leaders willing to move away from a NIMTO (Not-In-My-Term-of-Office) mindset and agreement on outcomes that were understood a decade ago. We must go further and build a consensus around ambitious goals and practical steps to achieve them. And certain stakeholders must take responsibility for overseeing this systemic change.

From my perspective working in academia, the role of universities and researchers in this change is to advance innovation, yes, and produce technologies that are inherently better for the environment. But we also have a broader role as the custodians of knowledge, with a responsibility to package this up in a way that makes new technologies practical for industries to apply and demonstrates why they are necessary.

In the pandemic, academics were behind the innovations that changed the course of Covid, driving forward the science, and producing and packaging the data in a way that healthcare systems and government could utilise to make decisions. Similarly for climate change, we need to help present practical uses for data and technology that can help drive the net zero agenda.

The challenge for researchers is overcoming the 'Valley of Death': the gap between industry demand and academic development. There are three necessary scaleups that must happen all at once to turn innovation into practical invention: technological, market and organisational. How do you scale and democratise the technology, so that it is accessible to all? How do you ensure the wider global market is ready to implement this on a systemic scale, so that it actually makes a difference? And how do you turn an academic start-up into an industry-influencing business that can deliver innovation at scale and pace?

In the context of sustainable technologies and how they are implemented, a significant step to address the development-delivery gap is in the positioning of green solutions. The ability to explain what is going on in terms of climate change, show how others have made progress and demonstrate practical outcomes is incredibly powerful.

We should therefore not position sustainability as a "good thing to do" from an environmental and moral standpoint. That only gets you so far with businesses who have bills to pay and shareholders to please. This needs to be a conversation about efficiency.

The same argument has been made around digital technologies over the past few decades. What slowed down this implementation was salespeople telling businesses that they "need" digital tools and doing this from a sales perspective, not demonstrating the practical business benefit. This is why so many industries even up to 2020 had not digitised to the level we may have expected. As soon as they become necessary in the context of the pandemic, businesses understood how these technologies could address their efficiency and productivity problems.

To prepare the market for sustainable technologies then, we need a narrative shift that makes the argument that sustainability is as much a conversation of efficiency as it is climate change. In manufacturing terms, if all factories simply became more efficient, then the by-product of that would be a greener industry.

The same goes for supply chain sustainability and innovation. If we think of supply chains as linear and geographically disparate, then it is easy for businesses to say what happens at the other end is not their problem.

If we develop the narrative however, so that we think of our supply chains as an interconnecting web, each member impacting the rest of the network, then it can be a motivator for organisations to think more carefully about supply chain visibility: who their suppliers are and where they are based. It puts the business imperative on companies to ensure they are only working with organisations signed up to specific codes of conduct and ethics, and not to turn a blind eye to sustainable malpractice.

A lot of this change must also be driven by consumers. While net zero cannot be achieved through individual habits alone, any person can make an impact by ensuring they know where their products come from and how they are made. We are all stakeholders in manufacturing and so, we can be directly responsible for driving change by being more selective about what we choose to buy.

We are at an irreversible moment in climate change right now that means we are dealing with symptoms rather than prevention. We must also accept that we still live in a consumerist society, with the goal of any business to grow and produce more. This will not change.

But I am an optimist and manufacturing will change for the better as consumers do. And if we intervene in the right way and communicate the efficiency benefits of more sustainable technologies and processes, then we can drive the change that we need.

"While net zero cannot be achieved through individual habits alone, any person can make an impact by ensuring they know where their products come from and how they are made."

Conclusion:

The roadmap to net zero exists now we need to follow it

Brian Palmer
Founder, Tharsus

The question that gets thrown at the manufacturing industry around its role in sustainability is an existential one: is it indeed possible for a sector that inherently is about producing, to drive net zero or is it fundamentally detrimental? If the industrial revolution was the starting gun for climate change, how do we continue to both embrace manufacturing and engineering production, and reverse centuries of impact?

The answer lies in technology. Today we are living through another industrial revolution, one driven by digital solutions that will allow us to create things that are better for people and the planet, and move them in a way that is more efficient and limits our carbon footprint.

The first step we must take is to remove existing silos that prevent collaboration. Individual innovation is one part of the equation but if businesses are not aligned, we will see a disparate set of ideas that do nothing towards systemic change. If we unlock the power of digital and data to develop intelligent strategic machines that enable collaboration, this will lead to an optimised use of resources that can reduce emissions and our global carbon footprint.

In speaking to our three experts for this report and a wider range of net zero leaders for a roundtable discussion prior to this, we saw examples of this collaboration in action and the storyboard for a greener future.

In nuclear power, we have one solution to end our reliance on fossil fuels – something that has only accelerated in necessity in today's geopolitical climate. But without the buy-in of governments to fund and subsidise this sector's growth, businesses to invest in nuclear energy and indeed, individuals in accepting its widespread use, we will be left with disparate green energy solutions that cannot be rolled out at scale.

Through supply chain innovation, we can better understand our supply networks, where our materials come from and how they are being exported and sold at the other end. If we can use open data shared between traditional competitors in the spirit of collaboration, then we can create a basic set of ethical guidelines that organisations must follow in order to import and export, then we can reduce the number of bad actors in a value chain.

And if we can secure buy-in as to the urgency of net zero and build a practical roadmap to achieving this, which leaders are willing to act on in their own terms and not push to future generations, then innovative academics and startups developing solutions on the frontline, will find a greater market for their ideas.

What gives me hope hearing from Andrew Storer, Veera Johnson, Tim Minshall and so many others, is that we are not short of the solutions. Innovation and technology has progressed to the extent that with accelerated research, development and implementation, our society and our industry can be net zero sooner.

But what we still miss, despite the rhetoric of COP26, is the understanding that green is gold. The biggest misconception of sustainable technology is that it is an additional expense that many smaller businesses in particular cannot afford.

While the initial outlay may incur costs, ultimately consumers are demanding that the products they buy are ethically sourced and produced, and increasingly will stop purchasing from those who do not do so. As a result, acting ethically is something that in the long-run will pay for itself, and the businesses who sustain themselves will be the ones operating sustainably.

We must give guidance to small businesses on how to begin their green transition, using tools such as Circulor to gain visibility over their supply chains, and being given the necessary subsidies to motivate a shift towards green energy and production processes. And industry leaders must speak with confidence about the potential of sustainability to deliver better profits alongside purpose.

At Tharsus, we are always looking to the future and as we continue our journey to engineer progress for the UK, we will continue our quest to unlock innovation, deliver more effective solutions, and create a better planet for years to come.

We have seen years of tech and digital transformation happen in months, successfully achieved not only through determination and focus but also unprecedented levels of collaboration. This, alongside the optimisation of networks, has achieved great things in accelerating exciting technologies, such as AI. Now, we must keep up the momentum, nurturing and developing these solutions to overcome the climate challenge ahead.

Achieving net zero does not mean returning to the stone age, it means looking to the next age. One where manufacturing can thrive by embracing the potential of technology to transform how we live. There is a roadmap to net zero that innovators have drawn up for us, now we must embrace a spirit of co-opetition and collaborate with our competitors to deliver systemic change.