NUCLEAR AMRC news

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Dawn of a new fusion cluster

UKAEA picks north Nottinghamshire for prototype fusion plant

The University Of Sheffield.

CATAPULT High Value Manufacturing

Future fusion: concept design for the STEP reactor.

Nottinghamshire to host prototype fusion power plant

The UK's prototype fusion energy plant will be built at the West Burton site in north Nottinghamshire.

The Spherical Tokamak for Energy Production (STEP) is the UK's bid to develop the world's first commercially-feasible fusion power station.

In June 2021, fusion developer UKAEA released an initial list of 15 potential sites to host the STEP demonstration site, and create a world-leading industrial cluster for low-carbon fusion power. That list was reduced to a final five candidates in October 2021, with UKAEA making its final recommendations to government in May.

West Burton, currently the site of a coal power station operated by EDF and a newer gas-fired station operated by EIG, has now been named as the winning location.

"Selecting the location of the STEP prototype plant is a huge, visible moment in the challenging and long-term endeavour of bringing fusion energy to the grid," said Professor Ian Chapman, UKAEA chief executive.

"West Burton is a natural fit for the STEP programme with a rich industrial heritage now being developed and repurposed for a low-carbon future. We look forward to working with people in the region to develop our ambitious plans and realising broader social and economic benefits."

The STEP programme will create thousands of skilled jobs during construction and operations, and attract other high-tech industries to the region.

UKAEA also announced that it will develop new apprenticeship training centres in Nottinghamshire, building on the success of its Oxfordshire Advanced Skills centre which trains around 180 apprentices from 25 employers every year.

"This is great news for Nottinghamshire and the wider region," commented Andrew Storer, CEO of the Nuclear AMRC. "The technology development required for STEP is incredible and a truly national effort is required. Having the site located near our facilities in Rotherham and Derby provides a great opportunity for Nuclear AMRC to really contribute to the supply chain manufacturing and skills challenges."

Last year, UKAEA opened its new Fusion Technology Facility at the Advanced Manufacturing Park in Rotherham, close to the Nuclear AMRC's research factory and less than 30 miles west of West Burton.

The Fusion Technology Facility is leading the development of technologies and materials for fusion power stations, including STEP, with the Nuclear AMRC supporting the team and partners on a number of strategically important projects.

The Nuclear AMRC is also part of the £3.5 million manufacturing support services framework for the STEP programme, which aims to develop advanced manufacturing processes in areas such as joining, forming, machining (including machinability studies with refractory materials – see p4), design for manufacturing, and non-destructive evaluation. Since the framework's launch in December 2021, the centre has successfully bid for a number of initial projects.

"Having the test centre located at Rotherham near the Nuclear AMRC was a great boost to our relationship, so having the STEP reactor located at West Burton adds to the positivity," Storer said.

Cluster creation

The STEP prototype is expected to create around 600 permanent high-quality jobs, with thousands more in construction and the supply chain.

"The STEP project will bring real benefits, including good jobs, opportunities for local companies and an ambition to drive skills and investment in the community," said Tom Greatrex, chief executive of the national Nuclear Industry Association.

"As we look to moving away from fossil fuels towards net zero, it is important that we find new ways of meeting our growing energy demands. Fusion offers the opportunity to produce virtually limitless energy that will power low-carbon economies across the world. The UK can play a central role in making that a reality."

The siting decision was welcomed by regional organisations as a driver for sustainable growth in an area with a long history of coal mining and power generation.

"In an area which has long suffered from under-investment, the site stands to play a crucial role in boosting local and regional economic activity, job creation and productivity," said Sir John Peace, chair of the Midlands Engine partnership.

"The project is more than a power station – it will require an ecosystem of innovation and development and will become a global focus for fusion power. This is an unrivalled opportunity to support our levelling up agenda by generating high quality jobs, building a first-class supply chain and further strengthening our regional skills base."

From coal to fusion: STEP alongside current power plant at West Burton.

The West Burton site benefits from connections to nearby manufacturing and construction firms, including the industrial clusters of South Yorkshire and Humberside, as well as the research capabilities of regional universities.

"The site is part of Megawatt Valley and has been crucial to the UK's power generation industry for decades," said Professor Martin Freer, director of the Energy Research Accelerator (ERA) based at the University of Nottingham.

"Fusion has the potential to be transformative for the way we produce energy here in the UK. It could provide an almost limitless supply of safe, clean electricity and help with the toughest decarbonisation challenges by using heat to manufacture hydrogen and synthetic clean fuels – other areas where our region and ERA have expertise."

EDF, operator of the West Burton A coal-fired power station which will soon be decommissioned, said it was delighted with the siting decision.

"The area has been associated with energy generation for over 60 years," noted Matt Sykes, managing director of EDF's generation business. "Developing such an exciting new project continues this tradition and has the potential to transform both the region and the UK's long-term energy supply."

STEP essentials

STEP is a government-backed programme to build a prototype fusion energy plant in the UK. The UK government is providing £220 million of funding for the first phase of STEP, which will see UKAEA produce a concept design by 2024.

The STEP plant aims to generate net electricity as well as demonstrating how the plant will be maintained and how it will produce its own fuel.

STEP will create thousands of highly skilled jobs during construction and operations and attract other high-tech industries to its host region, furthering the development of science and technology capabilities locally and nationally.

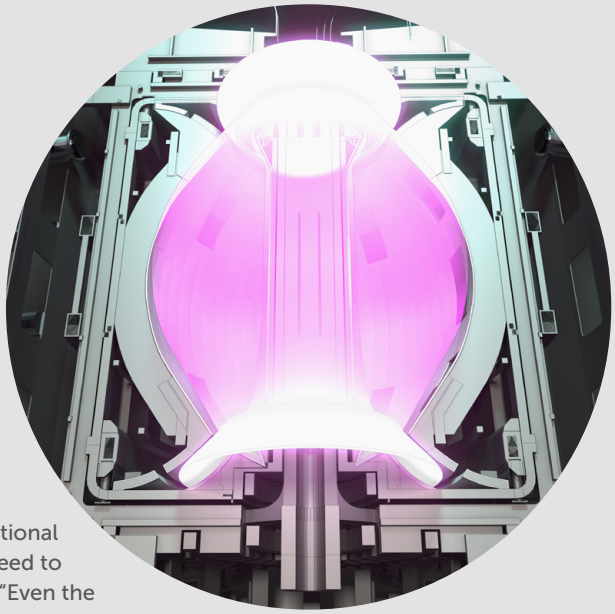
Fusion has the potential to provide a near-limitless source of low carbon energy by copying the processes that power the sun and stars where hydrogen atoms are fused to release energy, creating nearly four million times more energy for every kilogram of fuel than burning coal, oil or gas.

STEP will pave the way to the commercialisation of fusion and the potential development of a fleet of future plants around the world. UKAEA is targeting first operations in the early 2040s.

step.ukaea.uk

Tungsten machining will be key for fusion delivery

Improved techniques for machining tungsten will be vital to the delivery of fusion power projects, experts have warned.



Current fusion demonstration projects will require an estimated 300 tonnes of machined tungsten components, a demand which will stretch the ability of the supply chain to produce parts at the required volume and quality.

Tokamak fusion reactors are designed to operate at plasma temperatures of up to 150 million degrees, with the plasma confined by superconducting magnets operating at just 10–30 degrees above absolute zero.

"That's the biggest thermal gradient you can imagine," said Dr Paul Goodwin, manufacturing technology and equipment qualification group leader at UKAEA. "When you look at materials that can survive such operating conditions inside the tokamak, which are available and don't have radiation issues, you're basically looking at tungsten."

Goodwin was speaking at a meeting hosted by the Nuclear AMRC which brought together fusion experts with manufacturers and technology specialists, to discuss challenges in the machining of tungsten and other refractory materials.

There are very few companies in the UK capable of machining tungsten to the standards required by fusion projects, and limited capacity worldwide. Many tungsten parts are currently cut using electrical discharge machining (EDM) but, Goodwin noted, projected demand from fusion would exceed the global capacity of EDM systems.

UKAEA is looking into a range of ways to improve the manufacturability and performance of tungsten-based materials, but all are at a relatively early stage of technology readiness. In the near-term, the focus is still on conventional tungsten for components such as divertors, which remove helium and impurities from the plasma chamber.

Many such components have increasingly complex geometries, as reactor designers improve reactor efficiency and safety. Near-net shape methods such as additive manufacturing and hot isostatic pressing show promise, but still need finish machining.

"Whether we go with a conventional or unconventional route, we need to do machining," Goodwin said. "Even the best net shape process is near-net shape, and there's some need for machining or polishing to bring it to the dimensions and finish that's needed. There's currently no process in my view that would not benefit from improvements in machining."

Mike Jackson, prototype engineer in the divertor team at Tokamak Energy, highlighted the importance of surface finish for divertor components, and the risks of micro-cracking and induced stresses caused by machining. Tungsten is particularly challenging because of its extreme brittleness, as well as the very high rate of tool wear. "We can go through two tools per part," he noted.

The Nuclear AMRC called the meeting to develop ideas for a potential joint industry project (see box) to improve the capabilities and capacity of the UK supply chain for tungsten machining. The proposed project could cover cutting tool evaluation, machinability studies of tungsten produced by different routes, and the effects of techniques such as advanced cooling and thermally-assisted machining.

For more information about the tungsten project or other machinability research, contact: **andrew.wright@namrc.co.uk**

Joint industry projects allow companies to tackle common challenges in collaboration with the Nuclear AMRC and other organisations.

The projects bring together companies which are facing a shared technology challenge such as understanding the machinability of exotic alloys, or developing the code case for a new welding process. They are designed to solve shared problems in a faster and more flexible way than traditional collaborative R&D projects which depend on external funding.

This joint approach allows companies to leverage their R&D investment, and draw on the knowhow and resources of the Nuclear AMRC and partner organisations. Most joint projects will draw on early-stage research funded by the High Value Manufacturing Catapult

Projects are funded by a small consortium of companies, with results shared exclusively between the participants. They are suitable for companies of all sizes, at any tier of the supply chain.

To find out more:
namrc.co.uk/services/jip

H V Wooding wins new work in busbar collaboration

Specialist manufacturer H V Wooding has secured new business and is investing in new production capabilities as a result of a research collaboration with the Nuclear AMRC.

Kent-based H V Wooding, which specialises in precision engineered metal components for the automotive and aerospace sectors, worked with researchers from the Nuclear AMRC and other parts of the University of Sheffield to improve the quality of its busbars.

Busbars are insulated metal strips which carry high-current power between different parts of an electrical system.

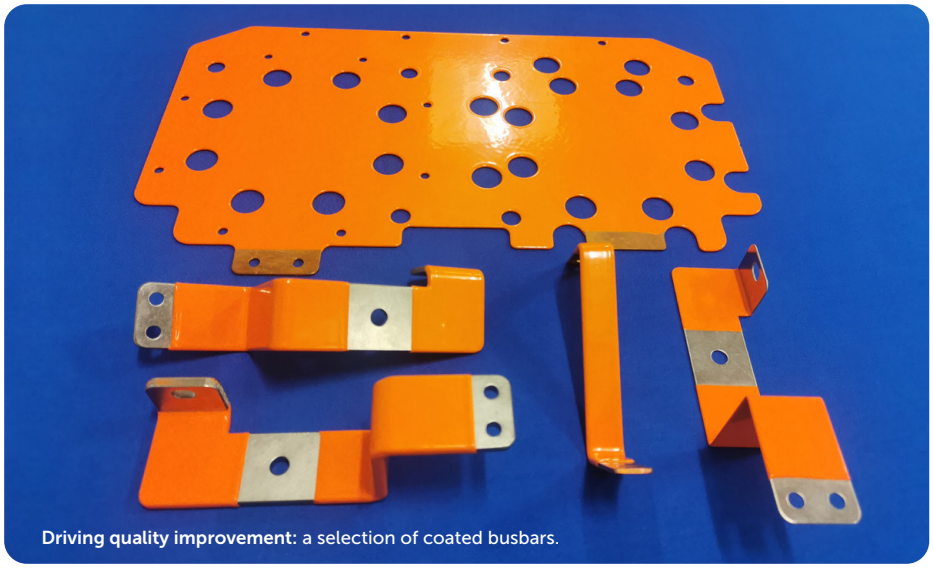
The project, supported by Innovate UK through the Faraday Battery Challenge, aimed to develop a new powder coating process to improve the quality and performance of busbars for the fast-growing electric vehicle market.

"We found that customers in the electric and hybrid vehicle market tended to specify their requirements in terms of kilovolt rating and insulation performance, not coating material or application method," says Simon Stewart, technical manager at H V Wooding. "The existing coating methods were difficult to control, causing a high level of component rejections due to the coating specification and application failing to meet requirements. Speaking with customers, it was clear that a new coating method was needed to produce busbars with a consistent specified performance."

With the demand for busbars expected to increase significantly as road transport is electrified, an optimised and automated manufacturing process would give H V Wooding a valuable competitive advantage in a rapidly expanding international market.

The project focused on epoxy powder coatings, applied by fluidised bed or spray processes. Powder coatings are generally safer than alternatives, and offer better thermal and electrical performance which allow for a more compact battery design.

The Nuclear AMRC researchers designed a series of experiments to be carried out at H V Wooding's production facility, to determine and optimise the key process variables for a variety of coating processes.



Driving quality improvement: a selection of coated busbars.

The researchers also worked with the company to optimise laser cutting and deburring of the metal busbar, as any surface burrs can affect the performance of the coating, and to define a standardised production process from stock material to final testing.

During the one-year project, the Nuclear AMRC team drew on additional expertise from the University of Sheffield. The AMRC – like the Nuclear AMRC, part of the High Value Manufacturing Catapult – advised on how the optimised process could be automated and scaled up, and the University's Department of Electronic and Electrical Engineering helped develop a standardised test procedure for quality assurance.

"The results have allowed us to better understand the relationship between the dielectric strength of the busbar and the coating thickness produced by the processes investigated," says Paul Allen, business development director at H V Wooding. "Even before the project finished, we secured new business as a result of the improved control of the busbar coating process. This contract has allowed us to invest in a nickel electroplating production line to enhance our production capacity and capability."

"H V Wooding has been a great collaborative partner to work with," says James Leatherland, the Nuclear AMRC's programme manager for collaborative R&D projects. "It's great to see a project that has had immediate benefits for a UK manufacturer, with business wins happening before the project has concluded. We think this project and the investment in the automated manufacturing process will put H V Wooding into a globally competitive position in a growing and important market."

H V Wooding previously worked with the Nuclear AMRC through the Fit For Nuclear programme, and is working through Fit For Offshore Renewables.

"Working with the Nuclear AMRC helped us achieve our aims – not just in achieving the initial required results, but the consistency required to make a commercially viable operation with investments continuing," Stewart concludes.

www.hvwooding.co.uk

Nuclear Skills Academy opens its doors

New look: the Academy is based in the former iHub building.

Rolls-Royce has opened the doors of its new Nuclear Skills Academy in Derby, with 200 new apprentices from all walks of life starting their nuclear careers.

The Nuclear Skills Academy is the first training centre of its kind, and aims to sustain nuclear capability within the UK's submarines programme by creating a dedicated pipeline of talent at the start of their careers.

The Nuclear Skills Academy is supported by industry and education experts, including the Nuclear AMRC, National College for Nuclear, University of Derby and Derby City Council. This ensures new apprentices have access to the best courses and mentors throughout their apprenticeship.

Rolls-Royce announced its plans for the Nuclear Skills Academy in May 2022 to huge interest from across the UK. More than 1,200 people applied for the 200 places available in its 2022–23 academic year, with the first apprentices entering the Academy in September.

"We are thrilled by the levels of interest in these apprenticeships, and it highlights how attractive a career in the nuclear sector really is," said Steve Carlier, president of Rolls-Royce's submarines business. "With the growing demand for clean carbon-free energy and with our submarines contracts with the MoD likely to sustain us into the next century, this could be a job for life for our new apprentices.

"Having started with Rolls-Royce as an apprentice myself and being born and bred in Derby, the launch of the Nuclear Skills Academy is especially exciting for me. I'm delighted that we are leading the way in developing nuclear talent for the submarines enterprise and proud that it will all be done in Derby."

For 60 years, Rolls-Royce has provided the power for all of the Royal Navy's nuclear submarines from its base in Raynesway, Derby. Their work ensures submariners have the power to protect the UK's interests at home and further afield.

The Nuclear Skills Academy has funding to provide 200 apprentices each year with nuclear education across four different courses for at least the next 10 years. The support of key industry organisations in driving the project forward has been invaluable for Rolls-Royce.

"We need to work together to tackle skills shortages which affect the whole nuclear sector," said Andrew Storer, CEO of the Nuclear AMRC. "The organisations backing the Nuclear Skills Academy will ensure that apprentices have the best training and support and develop the skills to deliver the UK's commitments for low-carbon power and national security."

Quality resources

In August, the Nuclear AMRC secured £1.3 million funding from Innovate UK to help fund bespoke training equipment and IT facilities for engineering apprentices at the new centre.

"High-quality training needs high-quality equipment tailored to the needs of the industry, and this new funding from Innovate UK helps ensure that apprentices at the Nuclear Skills Academy will be able to develop their skills on state-of-the-art equipment for advanced manufacturing,"

Storer noted. "As a former Derby apprentice myself, I am very proud that we are helping set a new standard for training in the sector."

The new funding was provided by Innovate UK to support the High Value Manufacturing Catapult's work in addressing future skills gaps in key industries.

"Innovate UK is working closely with the Catapults to invest in skills development, a critical part of driving innovation and capitalising on emerging technologies," said David Wilkes, director of innovation ecosystem at Innovate UK. "The additional £1.3 million funding to Nuclear AMRC for the Nuclear Skills Academy, provided by Innovate UK through the HVM Catapult, will help provide the foundations needed to strengthen the UK's R&D system to enable recovery and growth across the economy."

"The Nuclear Skills Academy is a much-needed investment in the skills that will enable low carbon power across the UK," added Katherine Bennett, CEO of the HVM Catapult. "By connecting our world-class engineers to the future workforce, we are making sure that the next generation is not just prepared for the cutting-edge technologies of today, but also the emerging technologies of tomorrow. This will ensure the right skills are available for a vibrant future economy."

Future talent

The apprenticeships are spread across all functions of Rolls-Royce including engineering, manufacturing and business. They provide fully-funded further and higher education qualifications, while the apprentices receive hands-on practical work experience within the business.

The courses are accredited through the University of Derby and National College for Nuclear (NCfN).

Deep learning: the Academy focuses on skills for the submarines programme.

"The Nuclear Skills Academy is a significant development for the sector, and the National College for Nuclear is delighted to be able to play a vital role in its creation and future development," said Helen Higgs, NCfN chair.

"Collaboration between ourselves, industry and education partners is at the heart of NCfN's delivery model and our vision, and this is a fantastic example of how that partnership can bring about world-class opportunities for many apprentices."

Professor Kathryn Mitchell, vice-chancellor of the University of Derby, added: "Equipping the future workforce with the skills and knowledge required to assure a pipeline of talent into the nuclear industry is crucial.

"Derby is a city at the cutting edge of engineering and manufacturing, with an internationally renowned reputation as a centre for industrial innovation. The Academy will further strengthen this and is set to be a game changer in how we respond, at pace, to the evolving skills needs of the country."

The Nuclear Skills Academy occupies a landmark building on Infinity Park Derby, formerly known as iHub and the first home for Nuclear AMRC Midlands (see box). The local partners hope that the new facility will help position the East Midlands as the centre of nuclear excellence in the UK.

"This is an exciting opportunity for the people of Derby which will help to further build our reputation as a city of innovation," said Councillor Chris Poulter, leader of Derby City Council. "It is vital that we bring forward the next generation into the nuclear industry and apprenticeships are a fantastic way for those of all ages to earn while they learn. The skills academy will also support key employers in the city and help to secure future talent in years to come."

Applications for the 2023–24 academic intake open from October 2022.

To find out more about apprenticeships with Rolls-Royce: **careers.rolls-royce.com/students-and-graduates/apprenticeships-and-school-leavers**

Construction on the new Nuclear AMRC Midlands facility continues ahead of schedule, with the 4,300m^2 building topped out in November.

Located alongside the new Nuclear Skills Academy on Infinity Park Derby and due to open in spring 2023, the new facility will expand the Nuclear AMRC's capabilities in areas including digital engineering, controls and instrumentation, and equipment qualification.

The facility is part-funded by £9 million of funding from the D2N2 Local Enterprise Partnership.

New members bring advanced manufacturing tech

Two manufacturing technology specialists have joined the Nuclear AMRC to support the development of advanced processes for the low-carbon energy sector.

Cutting tool specialist Kennametal UK and welding technology supplier Key Plant Automation have both taken tier two membership of the centre, helping them build their offering for the UK's nuclear supply chain.

Kennametal is a world leader in tooling and wear-resistant machining products, with customers across the energy sector and extensive experience in large component machining for power plant installations.

The company is targeting opportunities to support manufacturers working in growing low-carbon energy sectors including the nuclear, renewables and waste-to-energy industries.

As part of its membership, Kennametal UK will support the Nuclear AMRC's machining technology researchers in developing innovative and optimised processes for large high-value engineered components, helping manufacturers reduce cost, risk and lead times.

"Kennametal bring some exciting and innovative solutions to support our machining research," says Dr Krystian Wika, senior technical fellow. "We're looking forward to working with them to tackle challenges such as the machining of refractory metals and other difficult-to-machine materials, and to apply new tooling designs and advanced cooling techniques to energy sector applications.

"By collaborating with Kennametal, we can put more tools in the toolbox to help the UK supply chain meet the manufacturing challenges of new reactors and other low-carbon technologies."

Key Plant Automation will meanwhile work with the Nuclear AMRC's welding and materials research group to support the development of advanced joining processes for the most demanding industries and applications.

Based in Leek, Staffordshire, Key Plant is the UK's only major manufacturer of weld automation and positioning equipment, with over 65 years of experience serving sectors including power generation, shipbuilding, automotive and defence. The firm operates its own welding R&D centre to design and test specialist machines for challenging tasks such as deep narrow-gap welding.

As a member, Key Plant will provide specialist fabrication and manipulation equipment to support the Nuclear AMRC's research into advanced welding and cladding processes for the nuclear industry and other quality-critical applications.

"We are pleased to welcome Key Plant to the Nuclear AMRC," says strategic relationship manager Sean Murphy. "The equipment and expertise they offer will support our research into improving and enhancing joining techniques for the benefit of UK industry. In turn, we will help Key Plant understand the many and growing opportunities within the nuclear supply chain for advanced welding technologies."

www.kennametal.com

www.keyplant.com

Membership of the Nuclear AMRC provides the highest level of engagement and support, and a place at the heart of the UK nuclear manufacturing industry.

The centre is led by its member companies, from manufacturers and technology providers to OEMs and reactor developers.

Members benefit from significant business development and networking opportunities, help determine the Nuclear AMRC's research priorities and capabilities, and have the opportunity to leverage their R&D investment through board-directed research projects.

The two-tier membership structure and flexible terms allow membership to be tailored to a business's specific requirements. The annual fee – paid in cash or in kind – is a contribution towards the centre's shared resources.

namrc.co.uk/services/membership

Executive **view**

Delivering the UK's nuclear vision

Since spring, I've been spending a lot of time in Westminster working with industry and government colleagues to establish the framework for Great British Nuclear. This will be the vehicle to bring the UK's nuclear new build programme through the obstacles that have frustrated progress in recent years, and unlock our full potential to tackle the challenges of decarbonisation and economic growth.

There've been a lot of political changes in that time, but the Great British Nuclear report was submitted to Cabinet in September, and we keenly await the next step.

Simon Bowen and I will discuss the latest at the International Nuclear Manufacturing Summit in November, along with updates from the developers working to deliver our national target of 24GW of nuclear power by 2050. The Summit will also highlight the opportunities for the UK supply chain in global new build projects, with some 700GW of capacity in the pipeline.

Before we can plan the route forward, we need to understand how we got to where we are today. Over the past decade, the main reason that new build projects have stalled is down to the challenges of financing. The UK's position was that all new plant should be wholly financed and constructed by the private sector, which meant that technology and investment decisions were made elsewhere.

It's well known that different finance mechanisms could make nuclear a more attractive investment, and the UK has now introduced the Regulated Asset Base model for nuclear. This will reduce project risk for the investor and provide an income stream during construction.

There are also other ways to reduce the financing costs and risks of new nuclear. Rather than treating every new build as a one-off project, we can significantly reduce costs by building a fleet of reactors, using lessons learned to improve efficiency with every one.

New nuclear technologies can also make for a more attractive investment. Rather than the decade-long construction schedule for a gigawatt-scale reactor, small modular reactors offer a much shorter timescale and lower financing hurdles.

Modular designs can really help drive costs down, through factory production and assembly to minimise the costs and risks of on-site fabrication. We can learn a lot from industries such as shipbuilding, and from infrastructure and construction projects such as HS2 and the Olympics.

Learning from other industries is a great way to demystify the nuclear sector and expand the workforce to deliver these projects. Building 24GW of nuclear will need some 150,000 people. As part of Great British Nuclear, we set out a plan to bring in 11,000 new people by the end of this decade, and we will need to transfer skilled people from other sectors.

An ambitious new build programme will stretch the capacity and capabilities of the supply chain, especially if we want to capture as much of the value as possible within the UK. This has been the focus on my contribution to Great British Nuclear.

In recent decades, our nuclear supply chain scaled down to the available opportunities in submarines, decommissioning and fusion. Hinkley Point C has spurred some expansion, but not so much at the higher end of the value chain. The UK supply chain needs opportunities which aren't currently there, especially for large and high-end fabrications such as pressure vessels and turbines.

Building 24GW of new nuclear is a huge challenge. It'll mean working with supply chains to grow capabilities and capacity, setting up skills academies to provide a stream of new workers, providing support to reactor developers and confidence to investors, and putting words about net zero and levelling up into action.

We can do this, but the opportunity will not be there forever. We need to get moving before the UK loses out – otherwise, we'll first lose the opportunity to do it ourselves, and then the possibility of anyone else doing it for us.

It's all about making the decisions that will deliver our national vision, and following them through. We need to rapidly get to the point where there are clear policy decisions on the number of reactors we want to meet our energy and economic requirements to the necessary timescale, without another chain of papers continuously going through parliament.

Above all, we need to commit to a long-term plan that will deliver our commitments for 2050, and stick with the plan whatever else might happen in Westminster.

Andrew Storer, CEO

International Nuclear Manufacturing Summit 2022

UK capabilities + Global opportunities

16–17 November 2022, Magna, Rotherham

The Nuclear Manufacturing Summit returns this autumn with expanded coverage of opportunities for the UK supply chain in the global nuclear market, a new venue, and enhanced networking opportunities.

The UK is targeting 24GW of new nuclear power by 2050, and other countries are setting their own ambitious targets to support decarbonisation and energy security. With potential investment totalling hundreds of billions of pounds, there will be huge opportunities for nuclear-ready manufacturers.

From current gigawatt-scale projects to new designs of small and advanced modular reactors, along with continuing opportunities in the decommissioning and defence sectors, the scale of the potential nuclear market will challenge the capabilities and capacity of the supply chain.

The Nuclear AMRC's International Nuclear Manufacturing Summit 2022 will showcase opportunities in the major programmes and explore how suppliers can win work now and over the next 30 years.

This event is for UK manufacturers looking for opportunities in the nuclear market at home and worldwide, and wanting to play a part in the international mission to reach net zero emissions and reform the global energy market.

The first day focuses on the latest UK developments, with speakers including:

- Simon Bowen, **Great British Nuclear**
- Paul Spence, **EDF**
- Ivan Baldwin, **Bechtel**
- David White, **Rolls-Royce SMR**
- Ian Chapman, **UKAEA**
- Mick Gornall, **Cavendish Nuclear**
- Glen McCracken, **Sellafield**
- Corhyn Parr, **Nuclear Waste Services**
- Mark Rouse, **Dounreay**
- Declan Burke, **BEIS**

The second day expands to cover opportunities in key overseas markets, in partnership with the Department for International Trade and Energy Industries Council. Discover export and collaboration opportunities in territories including:

France, Germany, Central Europe, Japan, UAE, China, Canada, USA

Networking events include:

- Industry exhibition
- Pre-conference drinks at Sheffield's Winter Gardens
- One-to-ones with industry buyers
- Conference dinner on Wednesday 16 November

Venue

The **Magna Science Adventure Centre** is a hands-on visitor experience exploring the wonders of science and technology, and showcasing South Yorkshire's long history of industrial innovation.

Based in the former Templeborough steelworks, a few minutes from the M1, Magna offers a wealth of event spaces for conferences, exhibitions and networking.

Summit delegates will have the opportunity to experience the Big Melt show featuring one of the original arc furnaces.

www.visitmagna.co.uk

For the latest information and registration:
nuclearmanufacturingsummit.co.uk

Thanks to our event sponsors:

- Cavendish Nuclear
- Department for International Trade
- Energy Industries Council
- Jacobs
- Oldham Engineering
- Sandvik Coromant
- Severfield
- Sheffield Forgemasters
- Ultra Energy

Test space: TPT's workshop offers a range of specialised facilities.

Tyne Pressure Testing moves deeper into nuclear

Established in 2018 as a partnership between the British Engines group and Newcastle University, Tyne Pressure Testing offers specialist pressure testing services and dedicated assembly space to meet the most stringent requirements. Working with clients from a variety of demanding sectors, the Killingworth-based company verifies that components are fit for purpose and can operate safely under extreme pressures and environmental conditions.

The firm has driven business improvements through the Fit For Nuclear programme, and is now looking to win additional work in the sector. CEO **Paul Smith** discusses the company's journey and ambitions.

Tyne Pressure Testing was primarily set up to support subsea developments within the oil and gas industry. We operate nine hyperbaric chambers, including one of the world's largest commercially available facilities which can simulate water depths and temperatures down to 4,500m. Our work has developed to cover other sectors such as defence, mining, marine, aerospace and petrochemical.

We also started to carry out work for the energy sector, which we wish to further develop. Our first exposure to the nuclear industry was with Rolls-Royce's submarines business, where we carried out both assembly and testing work. We have also done work through Doosan Babcock for EDF, where we pressure-tested manifolds used on kill systems for reactors for a number of nuclear power stations.

We saw the Fit For Nuclear programme and what it brings it terms of approval status and increased exposure as an ideal means to try and secure further opportunities, and started our F4N journey in April 2021.

The assessment identified a number of areas for development. Most were areas we were aware of, but needed to do extra work to raise our standards. These included

accreditation of our management systems to ISO 14001, formalising our continuous improvement activities, reviewing value stream management, and business continuity planning.

We also had two areas identified which we had not started to develop. One was a formal project management closure and review process. We used to do everything through our contract review process at the front end, but our F4N industrial advisor Nigel Goodrich said there were benefits to be had from a project closure review in terms of what went well and any areas we could improve on. It becomes like a feedback loop.

The other was to develop SQCDP (safety, quality, cost, delivery and people) boards to disseminate business and departmental progress. We used to have morning meetings with the workforce, but SQCDP allowed us to formalise it and share more information than previously. It used to be about what we're doing today, but we're more focused now on health and safety, and where we are in hitting our delivery targets. It gets everyone more involved.

Driving continuous improvement

We developed and introduced an implementation plan that set out what we needed to develop, how we were going to develop it, and who had responsibility for the development. We shared this plan with the entire workforce, and held regular meetings to review progress and keep everyone updated.

The systems we have changed or introduced have not only helped us attain the standards required for F4N, they have also improved the effectiveness of our management systems. This has resulted in improvements in the way we communicate and interact with the workforce and stakeholders, enhancing the culture within the business.

Introducing a formal continual improvement system has been the biggest benefit for us. This has enabled us to engage with the workforce to discuss issues around improved performance from an operational, health, safety, environmental and quality perspective.

From these discussions, we developed a continuous improvement action plan and assigned the required closeout actions to team members. Because team members could see improvements being made and were actively involved in this process, the levels of frustration in the business dropped and teamworking and communication improved.

Deep capabilities: one of the world's largest hyperbaric chambers for commercial use.

We used to do a lot on an ad hoc basis – people were sometimes mentioning things but we wouldn't necessarily get them done. Now, because we formally register all these, we can assign actions, and we're closing them out to the satisfaction of the whole team.

Exceeding customer expectations

All told, the F4N programme has been a great help to improving our overall business performance, as well as making TPT a better place to work with improved job satisfaction all round. We hope the journey we have undertaken will help open up new opportunities for the business, not only in nuclear but also in other sectors.

Our engagement with F4N has only recently begun, and we have not as yet secured any work directly attributable to it. We do however believe that involvement in F4N will give us increased exposure within the nuclear sector and opportunities to sell our service offerings.

We see further opportunities in our core offerings of pressure testing and assembly work. We want to build on our current nuclear related work through delivering an exceptional service to exceed customer expectations that will put us in good position for additional work, along with recommendations to others to use our services.

We also want to fully utilise the opportunities from being a granted company within the F4N Connect programme to showcase our capabilities to the nuclear sector audience.

In five years' time, I hope that we will be well established in the nuclear sector with a larger customer portfolio, and possibly an extended service offering to meet the needs of existing and future customers.

We are very customer focused, and we will try where possible to support customer needs. If this involves investment in people or equipment to achieve this objective, then that will be considered.

We want to be known as the go-to company for pressure testing and assembly services, which is prepared to support and take on work that fully meets customer needs, and to build longstanding business relationships.

tynepressuretesting.com

F4N
Fit For Nuclear

Congratulations to the latest companies to be granted Fit For Nuclear

These companies have benchmarked their performance against the standards demanded by the nuclear industry's top tiers, and driven business improvements.

Tyne Pressure Testing is a specialist pressure testing and assembly facility that provides a variety of services to the nuclear industry and other sectors.
tynepressuretesting.com

Yokogawa UK is a leading provider of industrial automation, test and measurement solutions.
www.yokogawa.com/uk

Congratulations also to **Capula** and **Ultra Electronics Energy** on being regranted F4N.

For details of all F4N-granted companies: **namrc.co.uk/services/f4n/companies**

F4OR
Fit For Offshore Renewables

Fit For Offshore Renewables (F4OR)

is a collaboration between the Offshore Renewable Energy Catapult and the Nuclear AMRC, based on the proven Fit For Nuclear model of supplier development.

ore.catapult.org.uk/f4or

Congratulations to the latest companies to be granted F4OR.

Houlder specialises in engineering design, clean technology and technical consultancy for the marine and offshore environments.
www.houlderltd.com

North Star Renewables is delivering a new fleet of bespoke service operation vehicles to meet the evolving demands of offshore wind.
www.northstarshipping.co.uk/our-services/renewables

Optimus Plus (Aberdeen) is an integrated engineering consultancy and project delivery company.
optimusaberdeen.com

Whittaker Engineering designs, builds, supplies, fits, maintains and repairs components and equipment for the marine and offshore industries.
www.whittakereng.com

Applications close for hydrogen and carbon capture pilot

Almost 100 companies from across the UK registered their interest in joining the pilot Fit For Hydrogen (F4H2) and Fit For Carbon Capture, Usage and Storage (F4CCUS) programme.

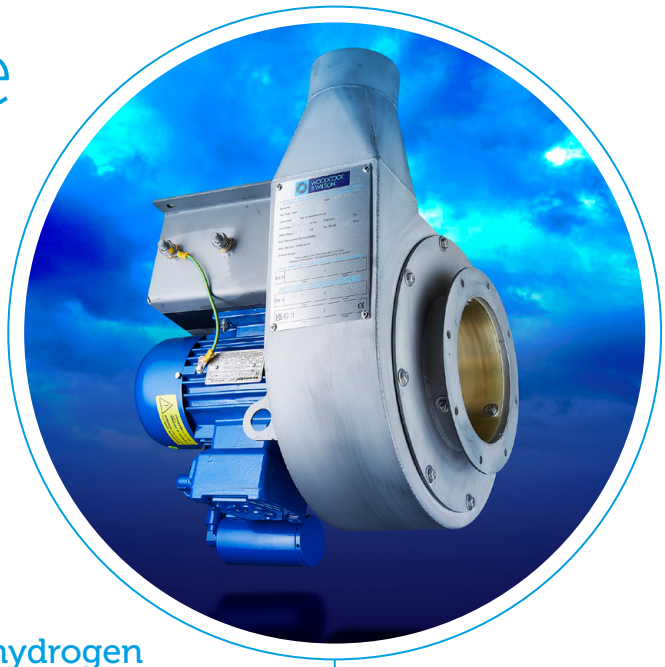
The project is part of the Nuclear AMRC's work for the Zero Carbon Humber partnership, a major collaboration to clean up the UK's most carbon-intensive industrial cluster, with support from the UK government's Industrial Strategy Challenge Fund.

The pilot phase will involve up to 30 companies entering and progressing through F4H2 and F4CCUS. Selected companies are now being invited to start their journey, in which they will be supported by the Nuclear AMRC's regionally-based industrial advisors.

As with the established F4N and F4OR programmes, the pilot will combine assessment against a variety of business excellence measures with sector-specific assessment and development activities.

For the latest information: **namrc.co.uk/services/zch-supply-chain**

Safety first for the hydrogen market



Ex-rated: industrial tank vent fan by Woodcock & Wilson.

As the UK's leading manufacturer of fans for explosive atmospheres, Woodcock & Wilson has a unique perspective on hazardous area safety. The Huddersfield-based firm was first granted Fit For Nuclear in 2018, and is now preparing to begin the pilot Fit For Hydrogen programme.

Sales director **Scott Harding** explains why the hydrogen sector presents some additional challenges for manufacturers.

As we move towards a hydrogen economy, has manufacturing got the correct safety culture for this fast-growing industry?

The need to safely handle hydrogen gas is obvious, but industry awareness of the requirements that regulate the design of equipment is sadly lacking among end users and manufacturers alike.

In terms of explosive potential, hydrogen is classified as a Group IIC gas. Even relatively low concentrations of hydrogen in any environment are extremely vulnerable to ignition by spark or flame.

Any hazardous area equipment should be designed to limit potential ignition sources. This is detailed in the ATEX directive, the European standard governing the production of equipment used in explosive atmospheres, although this does not list any technical standards that manufacturers must comply with.

Under the ATEX directive, manufacturers are responsible for the conformity of the product with all the requirements of the applicable legislation. This means that manufacturers do not need to work to any EN or ISO technical standards to declare their products as ATEX compliant.

For non-electrical equipment which will be used in hazardous areas rated as Zone 1 (where explosive atmospheres are likely) or Zone 2 (a lower risk), there is no legal requirement for a notified conformity assessment body to check the product design, testing or inspection to satisfy the ATEX directive.

Instead, fan manufacturers can produce a legally self-certified product which offers absolutely no guarantee the design is correct. Self-certification or the lodging of technical files can be open to misunderstanding, and lead to mistakes being made and unsafe equipment being put into service.

Under the Health & Safety at Work Act, end users are ultimately responsible for ensuring products being installed are compliant with the ATEX directive. So how can end users guarantee these products meet the requirements?

For a low-risk Zone 2 fan, this might be a risk that a client is willing to take – but is the same true where hydrogen is concerned?

If we look at the international IECEx certification system for equipment used in explosive atmospheres, this will not allow for any self-certification of products. This provides full and complete transparency.

The risks of self-certification have been highlighted by users including the US Coast Guard, which will now not accept ATEX self-certification.

At Woodcock & Wilson, we believe safety should be paramount. As part of our safety culture, we have taken our products to the next stage.

We have worked with UK accredited bodies, EU notified bodies and IECEx to produce a range of fans with third-party certification, and to identify the correct ISO and EN standards that are critical in the assessment and testing of our products.

This now puts Woodcock & Wilson at the forefront of providing safe mechanical equipment for hazardous areas in non-electrical process industries. We are currently the only fan manufacturer to offer our whole range with independent third-party unit verification. This independent certification allows us to produce fans for Zone 1 hydrogen applications, where a IIC explosive gas atmosphere is likely to occur in normal operation.

We have recently been invited on to the working committee at IECEx to develop new safety requirements for the widespread use of hydrogen gas as a fuel, feedstock and energy storage medium, and are now beginning the Fit For Hydrogen pilot programme with the Nuclear AMRC to further develop our capabilities for this important and growing market.

For more information, contact **scottharding@fanmanufacturers.com**

Nuclear jobs hit new high

Nuclear industry employment is at its highest level in five years, according to the latest jobs map from the Nuclear Industry Association (NIA).

The annual study shows that the civil nuclear sector employs 64,509 people across the UK, an increase of more than 3,000 from 2021. However, the NIA warns that urgent investment is needed to sustain that trend and ensure that nationally critical skills are not lost as the existing nuclear fleet retires.

"The nuclear industry stands alone in sustaining tens of thousands of high-skilled, well-paid jobs which make a significant contribution to UK energy security and our net zero future," said Tom Greatrex, NIA chief executive. "We can have more of these jobs and opportunities for the next generation if we get on with building new stations – both a fleet of modular reactors and large-scale plants – to meet the government's commitment for more secure, reliable and British power."

EDF's new build project at Hinkley Point C, the largest construction site in Europe, currently employs around 8,000 people. More than 1000 apprentices have been trained on the project, and it will continue to support thousands of jobs across the country as it begins its next major phase.

Innovations in advanced nuclear technology have also driven the sector's strong employment presence. Rolls-Royce SMR has already created more than 330 jobs since its launch in late 2021, and a national programme of SMR deployment could create 6,000 more. And more than 2,200 people are working on nuclear fusion development at the Culham Centre for Fusion Energy in Oxfordshire.

North-west England remains the largest region for the industry, with more than 25,700 people working in decommissioning, fuel cycle research, reactor design and other disciplines. Another 15,000 work in the south-west, where the Hinkley Point C project has led to £4.1 billion invested across the region.

"This jobs map shows just how important the nuclear industry is to the UK, providing good, well paid, unionised jobs which offer real career opportunities for working people up and down and the country," commented Andy Prendergast, national secretary of the GMB union.

www.niauk.org/nia-jobs-map-2022

Waste depository to create more than 4,000 jobs

The proposed Geological Disposal Facility (GDF) would create more than 4,000 jobs during the first 25 years of siting and constructing.

An initial study by Nuclear Waste Services (NWS), a subsidiary of the Nuclear Decommissioning Authority, sets out how the multi-billion-pound programme would create thousands of skilled jobs for over a century.

The GDF will be one of the biggest infrastructure projects in the UK, providing a major investment for the local host community. Work on a GDF will carry on for about 175 years, and could provide significant additional investment through increased business opportunities, infrastructure and facilities.

Employment will be generated at the facility itself and in its supply chain.

"The long-term nature of the project provides a unique opportunity to develop skills, expertise and sustainable jobs for a local community," said Karen Wheeler, deputy CEO of NWS. "We are now making real progress and having conversations with a number of communities about the potential for them to host a GDF."

NWS is leading the search for a suitable site, which will be based on community consent and detailed investigations over a number of years. Community partnerships have already been formed in Mid Copeland, South Copeland and Allerdale in Cumbria, and Theddlethorpe in Lincolnshire.

www.gov.uk/government/publications/gdf-creating-jobs-skills-a-first-look

EDF trains 1,000 apprentices

EDF has hit its goal of training 1,000 apprentices during construction of the Hinkley Point C power station.

The target was set during the planning stage of the project, as part of EDF's commitment to maximising opportunities for local people.

"It's fantastic that we've hit this milestone just six years into construction," said Nigel Cann, delivery director at Hinkley Point C, who started his own career as an apprentice. "I'm proud our project has played such an important role in helping to kickstart so many exciting careers."

Two thirds of the apprentices live within the local area. Travis Redfern is from Taunton, and training as a digital engineer apprentice with civil works contractor Bylor.

"I originally wanted to be a primary school teacher but, after hearing about Hinkley Point C's apprenticeships, I decided to change directions," he said. "I'm so glad I did – I'm passionate about the project and I'm learning so much. It's setting me up for the future."

Charlotte Casey from Bridgwater graduated from her nuclear engineering apprenticeship in the summer, and is now working on site as an operational development engineer.

"My course was action packed, with training in everything from nuclear science to safety and regulation," she said. "I've now secured a permanent job on the project, and my aim is to see Hinkley Point C through to commissioning."

EDF says the apprenticeship programme's success is thanks to extensive outreach work with local schools and colleges. Partnerships have been set up with training providers, creating a pipeline from the classroom to employment.

"We are absolutely delighted to have supported Hinkley Point C in training its apprentices, and this is a huge milestone," said Andy Berry, principal and CEO of Bridgwater and Taunton College. "Reaching this point ahead of schedule is even more of an achievement, and we look forward to the next stages of the project's development."

EDF has also invested £8 million into three centres of excellence in Somerset, specialising in welding, mechanics, and electrics.

Secure job: operational development engineer Charlotte Casey.

Apprenticeships will continue to be offered as construction progresses at Hinkley Point, with opportunities open to anyone regardless of experience, background, or age.

EDF, a tier one member of the Nuclear AMRC, also aims to train at least 1,500 apprentices at Sizewell C. The proposed new build project in Suffolk received development consent from the UK government in July, with EDF expected to make a final investment decision in 2023.

www.edfenergy.com/careers

Set up for the future: digital engineer apprentice Travis Redfern.

Sheffield Forgemasters to work with GE Hitachi on SMR development

Sheffield Forgemasters will work with GE Hitachi to support the potential deployment of the US-based group's small modular reactor in the UK.

UK ambitions: GE Hitachi's BWRX-300 small modular reactor.

A founding member of the Nuclear AMRC, Sheffield Forgemasters specialises in the design and manufacture of high-integrity forgings and castings. The firm has a long history in the nuclear sector, including ongoing work for the UK submarine programme and current development projects with Rolls-Royce SMR and General Fusion.

Forgemasters has now signed a memorandum of understanding with GE Hitachi Nuclear Energy (GEH) to discuss how its existing and future capabilities could help meet the potential demands of deploying the BWRX-300 small modular reactor (SMR).

"SMRs have the potential to become a standard for civil nuclear power generation and as an emerging technology, our long track record of supplying nuclear grade components brings a wealth of technical forging experience to the market," said David Bond, CEO of Sheffield Forgemasters.

Forgemasters was acquired by the Ministry of Defence in 2021, to protect its crucial capabilities for the UK submarine programme. The company has embarked on a 10-year recapitalisation programme, which has already seen the acquisition of a new 13,000 tonne forging press and two large vertical turning lathes, with initial work underway to build a new 13,000m^2 forge building.

"Sheffield Forgemasters is undergoing a transformation to Industry 4.0 manufacturing technologies, the centrepiece of which is our investment of up to £400 million over 10 years to replace the company's defence-critical assets," Bond said. "We look forward to working with GEH to explore the possibilities of becoming a UK supply chain partner in the delivery of complex nuclear-grade forgings into the commercial BWRX-300 SMR build programme."

GEH is an alliance of GE and Hitachi serving the global nuclear industry. Its BWRX-300 reactor has been designed to achieve construction and operating costs which are substantially lower than traditional nuclear technologies, and could be deployed as early as 2028.

"As the UK government aims to expand nuclear power capacity to 25 per cent of the nation's electricity needs, we are pleased to be working with an industry leader like Sheffield Forgemasters to discuss a potential supply agreement for forgings in support of the deployment of BWRX-300 SMRs," said Sean Sexstone, executive vice president for advanced nuclear at GEH. "We will also look at how Sheffield Forgemasters' unique capabilities can help meet the growing global interest in the BWRX-300."

The BWRX-300 is a 300 MWe water-cooled, natural circulation SMR, with passive safety systems adapted from the US-licenced ESBWR. GEH says its life-cycle costs will be similar to those of conventional natural gas combined-cycle power plants.

www.sheffieldforgemasters.com

nuclear.gepower.com

Moltex unveils flexible reactor design

Advanced reactor developer Moltex Energy has announced details of its new flexible technology which it says can reduce energy bills while helping balance the variability of renewable generation.

Moltex says its Flex reactor has the flexibility of gas-fired power stations, but with near-zero emissions and a target cost of around £40/MWh, similar to wind power.

Flex is a thermal neutron moderated version of Moltex Energy's stable salt reactor technology. The Canadian business has established a new Warrington-based subsidiary, MoltexFlex, to develop the reactor.

Flex's patented system uses two molten salts: one acting as a fuel, the other circulating as a coolant. This allows the heat from the reactor to be extracted through natural convection, without the need for pumps. The simplified design also means that Flex doesn't require expensive steel and concrete structures, reducing the operational and maintenance costs.

With no moving parts, Flex can rapidly respond to changes in energy demand, automatically entering an idle state or returning rapidly to full power. The reactor produces heat at 750°C, which can be used for water desalination and more efficient hydrogen production, or linked to a thermal storage facility.

Flexible friend: concept design for a power plant with 32 Flex modules.

Each Flex module produces 40MW of thermal power, or 16MW of electricity. The modular design means that a 500MW power plant could be built in just two years, Moltex claims.

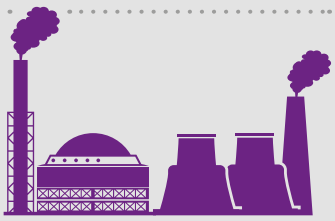
"We recognised the need for an energy supply that can support renewables when the sun doesn't shine or the wind doesn't blow," says David Landon, MoltexFlex CEO.

"The Flex reactor provides the safety net of affordable domestic energy, but is versatile enough for applications ranging from decarbonising heavy industry to powering cargo ships."

The Nuclear AMRC has previously worked with Moltex Energy on manufacturability and supply chain projects to support development of its reactors.

www.moltexflex.com

New standards needed for manufacturing emissions



Attempts to reduce greenhouse gas emissions from the manufacturing supply chain could be undermined by a lack of standards for carbon accounting.

Manufacturing produces 40 per cent of the UK's consumption-based carbon dioxide emissions, but efforts to measure and reduce emissions suffer from the lack of a common accounting framework. According to a new report from the High Value Manufacturing Catapult, industry needs a universal methodology for measuring and reporting emissions, based on metrics agreed with government regulators.

"Tracking carbon emissions is now an integral part of a company's annual audit," says Katherine Bennett, chief executive of the HVM Catapult. "Yet, a myriad of different carbon accounting standards and methodologies are used, meaning that the data is rendered almost useless when combined across the manufacturing sector.

"Given the energy intensive nature of manufacturing, this lack of common data makes tracking overall emissions reductions almost impossible, and vital information can be obscured or lost. This risks completely undermining the UK's drive to net zero."

The *Embodied Emissions and Net Zero* report highlights a particular problem with scope three emissions – indirectly produced emissions, such as materials extraction and processing – which account for up to 90 per cent of emissions from manufacturing.

The report notes that smaller businesses will need assistance to understand carbon accounting.

To download the report, go to:
hvm.catapult.org.uk/resource-hub

Work **with us**

The Nuclear AMRC is here to support manufacturing companies, from SMEs to global giants, which are seriously interested in winning business in the nuclear sector.
If we can help your company, we want to hear from you.

We help manufacturers through **supply chain development** and **innovation**.

We can work with you to raise your quality, capability and cost competitiveness to meet the needs of the global nuclear industry.

And we can develop world-leading manufacturing processes and technologies. We have the production-scale facilities and the manufacturing expertise to help you improve cycle time, reduce lead time, improve quality and reduce costs.

Our capabilities and services are open to all UK manufacturers. We provide a responsive service to help you solve your manufacturing challenges and win new work.

We also offer full membership, giving you access to our generic projects and the opportunity to determine our core research.

To find out more about how we can help you win work, contact the Nuclear AMRC business development team:
business@namrc.co.uk

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