UK Atomic Energy Authority

Fusion Futures End of Year Report 2024-2026

Foreword

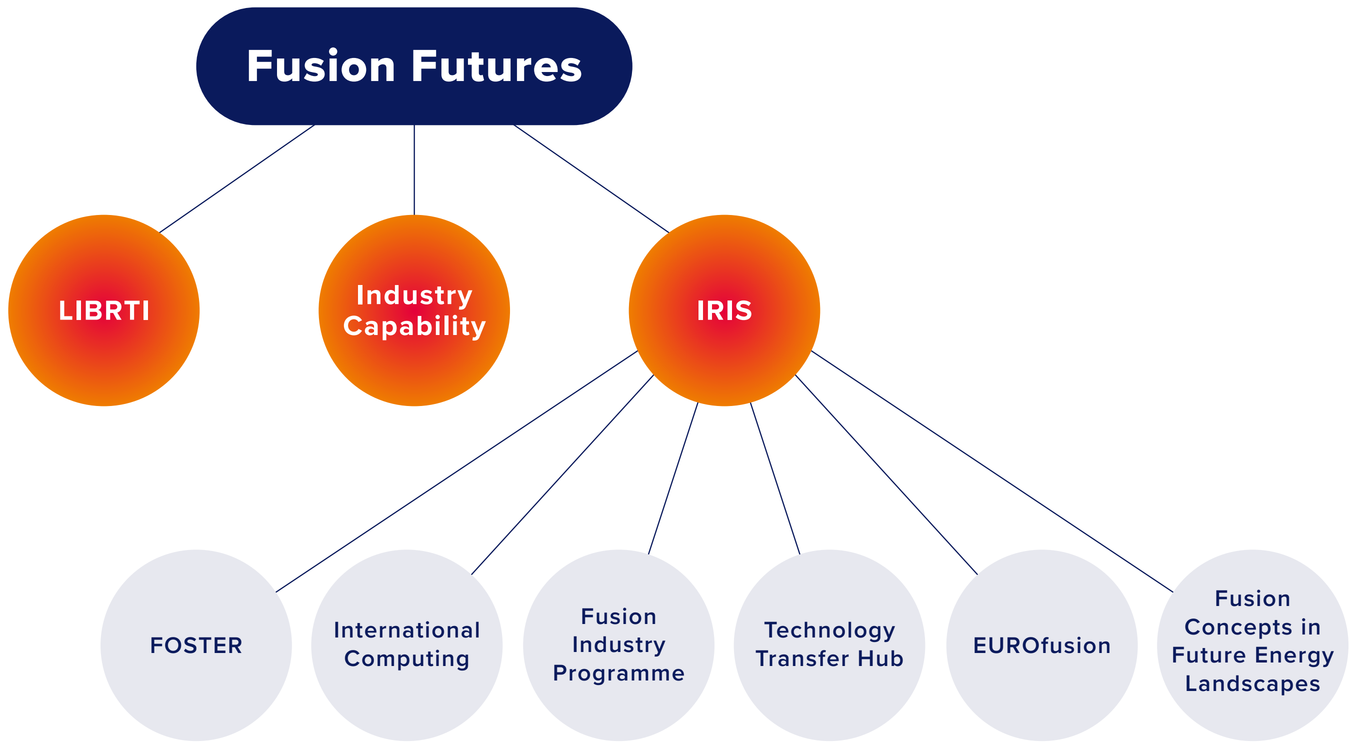
Over the past two years the Fusion Futures programme has delivered significant benefits for the UK fusion ecosystem. This report highlights those benefits, delivered through a broad range of targeted interventions. From the growth of industry capability in the supply chain, the development of key skills, and the establishment of first-of-a-kind facilities, the programme has made a sizeable impact on the fusion sector. Delivered by UKAEA and hundreds of partners across the ecosystem, over the last two years Fusion Futures has moved the UK one step closer to the ultimate objective of commercial fusion energy, whilst securing value for the UK economy in the short term. Two years of delivery have yielded impressive results, with a number of elements primed to continue over the coming years. This report is an overview of the programme's achievements; we hope you enjoy reading through these highlights. If you're interested in finding out more about any of the work outlined here, please contact communications@ukaea.uk

The Fusion Futures Team

Fusion Futures Programme Objectives

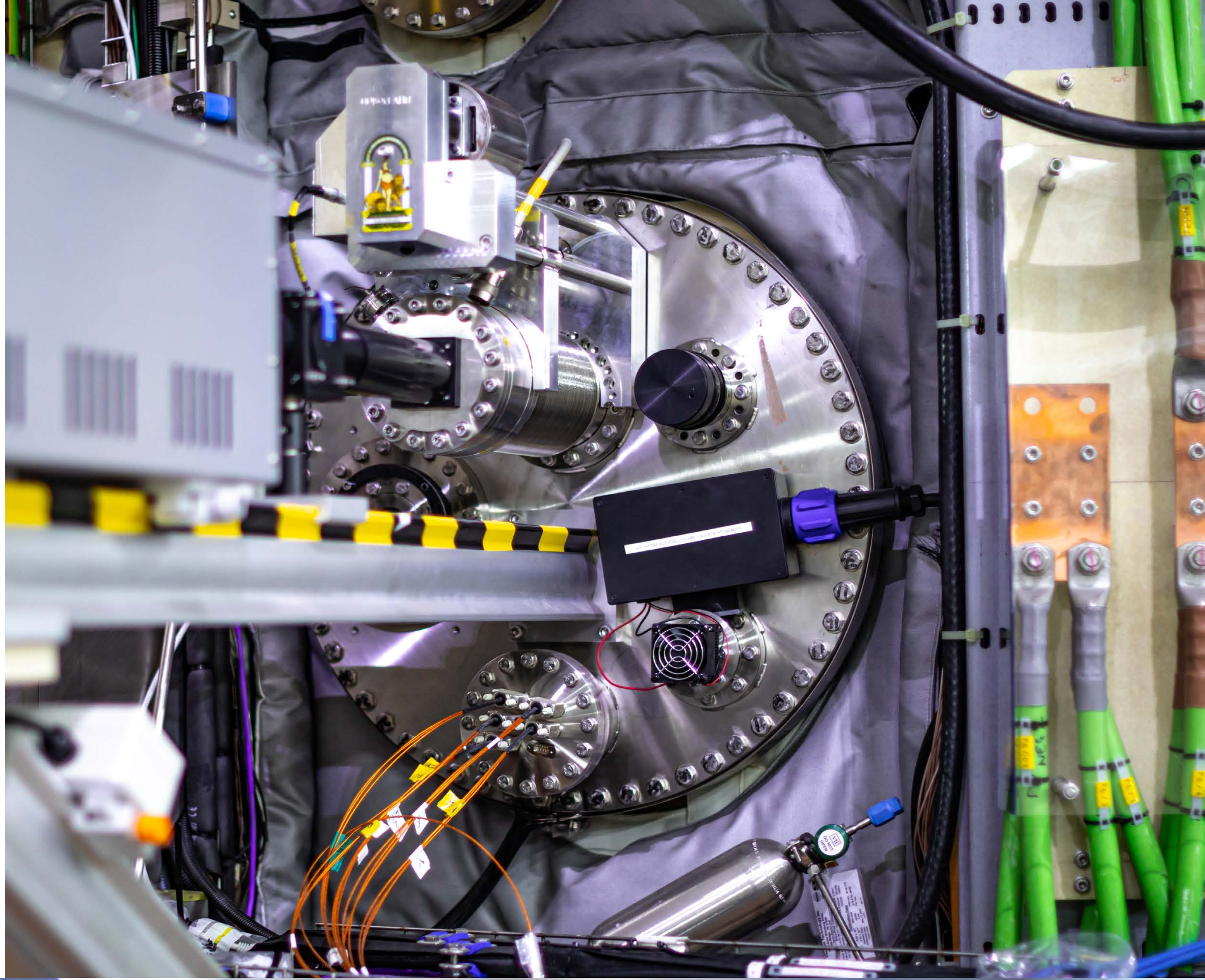
- To maintain essential fusion research conducted in the UK and seek mutually beneficial international collaborations.
- To enable the UK to maintain its global technical lead in fusion through the delivery of domestic capabilities.
- To create a strong UK industrial sector that leads the world in operationalising and commercialising fusion energy.

Programme overview



Programme highlights 2024-2026

- Over 200 industry partners engaged, delivering scientific and financial benefits across the UK fusion supply chain and wider fusion ecosystem.
- Over 50 UK and international universities engaged on a broad range of scientific and commercial activities through multiple projects, from experimental research to programme delivery.
- Over £100m invested in partners across the fusion ecosystem.
- Neutron source procured for groundbreaking tritium breeding experiments at a new Oxfordshire facility as part of LIBRTI programme.
- Civils contract of £34.1m was awarded to McLaughlin and Harvey Ltd to for the design and build of LIBRTI facility.
- International computing collaborations delivered with world leading companies, leveraging access to infrastructure worth billions of pounds.
- Two spinouts created, with several more to follow in 26/27.
- Over a thousand people have engaged in the programme's FOSTER skills drive, from apprentices to doctoral students.



OBJECTIVE 1: to maintain essential fusion research conducted in the UK and seek mutually beneficial international collaborations.

Fusion Futures has strengthened the UK's position as a global leader in fusion science, showcasing UKAEA's research excellence and international standing. Some key examples include UKAEA's partnership with EUROfusion, which has delivered a series of crucial advances for fusion.

Supporting the UK's fusion leadership through partnership

Critical research has also been carried out by the **EUROfusion** programme, which has supported the UK's international position in relation to the realisation of commercial fusion power. A number of projects have helped realise the first Fusion Futures objective, including the European Tokamak Network and Operations. This involves the development of our understanding of burning plasmas through theoretical, modelling and experimental projects. This includes operating EUROfusion research campaigns on tokamak machines such as Culham Campus's MAST-U, the analysis of Joint European Torus (JET) data, and UKAEA access to EUROfusion facilities.

In relation to materials research, UKAEA has played the leading role in partnership with EUROfusion in analysing fuel retention in the JET tokamak during Deuterium-Tritium campaigns. In addition, the UKAEA high-heat flux facility HIVE has carried out testing of tungsten samples for COMPASS-U/EUROfusion to allow COMPASS-U to use multiple tungsten suppliers to avoid single-supplier procurement.

EUROfusion computing work has focused on the transport and retention of tritium inside a fusion power plant. Models have been validated by dedicated experiments, performed at IPP Garching, Germany, and Jozef Stefan Institute, Slovenia.

KEY STATS

EUROfusion
2024 - £11 million over 15 work packages.
2025 - £11 million over 15 work packages.

Industry Capability
Over 100 secondees and placements at 28 host organisations in 9 countries.

Transcending boundaries, bounding over borders

In addition to the delivery of this technical research excellence, Fusion Futures has upskilled dozens of young scientists through the **Industry Capability** secondments programme. More than 70 secondments have taken place this year, in addition to the 42 facilitated last year. This has enabled UKAEA employees to access world class facilities via a range of host organisations, leading to significant upskilling. This is of benefit both to UKAEA and the wider sector, whilst enhancing and securing additional value for the UK economy.

Soren Bentley on secondment at The University of Rochester, USA.

> As a graduate engineer, the University of Rochester secondment has provided valuable hands-on experience while contributing to the development of permeation barrier coatings that will be key components in the future fusion fuel cycle.

Soren Bentley,
Fusion Technology

Mapping out the future – the energy of tomorrow

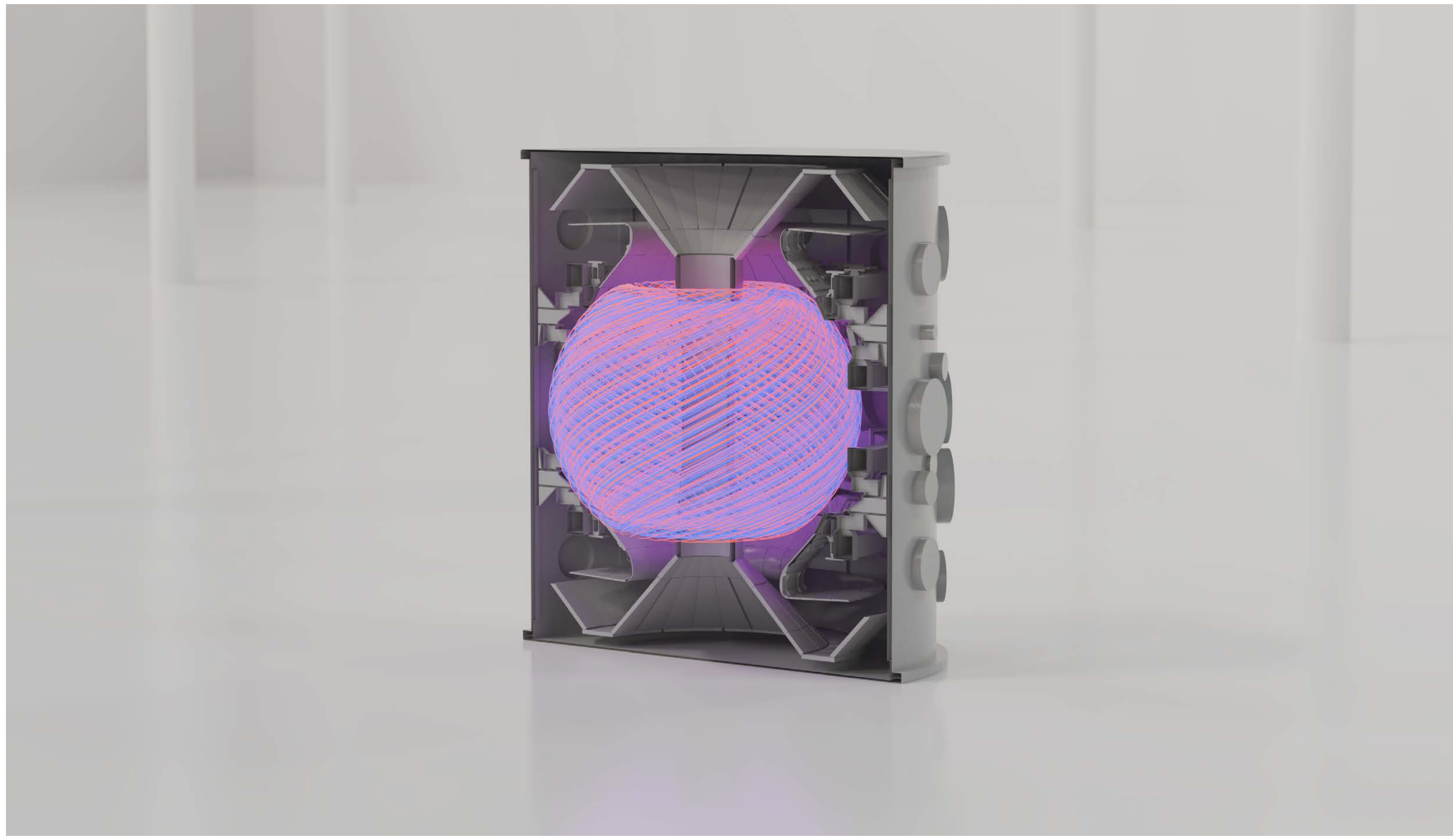
Further groundbreaking Fusion Futures research engaged AtkinsRéalis to undertake the **Fusion Concepts in Future Energy Landscapes** project. This is a novel first-of-a-kind exploration of pull factors, using non-fusion subject matter expert input to start to understand what energy systems might look like in various putative geophysical, socio-economic and geopolitical ecosystems around the world, at times well beyond the range of existing forecasting tools. These archetypal ecosystems were then tested against potential climate and geopolitical disturbances. The aim is to deduce which "deployability factors" would help or hinder introduction of (any) new power plants, and whether these should influence research and development directions and strategies for fusion. The short first study in 2025/26 indicates such an activity can be very illuminating.

Collaborating to compute

Meanwhile, the **International Computing** programme has delivered a number of key projects spanning the past two years:

- The collaboration with the Science and Technology Facilities Council (STFC) Hartree Centre and Argonne National Laboratory (ANL) has improved the real-world performance, usability, and multiphysics capability of fusion computational tools by streamlining workflows, boosting efficiency, and strengthening core libraries. By coupling in greater system complexity at scale, the work is enabling more integrated and actionable prediction of rare "black swan" events before they occur. Together, these advances reduce manual steps and time-to-result, allowing UK researchers to run larger, faster, data-integrated studies and move more quickly from experiment to insight, thereby supporting the UK's technical lead.
- The International Atomic Energy Authority (IAEA) collaboration helped build an emerging international fusion data-sharing capability by improving reliable data ingestion, extending common data structures, and delivering Application Programming Interfaces (APIs) for easy querying and visualisation – boosting interoperability and cross-device comparison, enabling reuse of high-value datasets, and accelerating research (including machine learning) without bespoke pipelines.
- The collaboration with Idaho National Laboratory (INL) including Lawrence Livermore National Laboratory (LLNL) and STFC, has strengthened open-source multiphysics simulation capability by integrating the highly scalable MFEM finite element library into the MOOSE ecosystem and developing MOOSE's support for execution on large-scale GPU-based HPC systems such as SUNRISE – improving usability and large-problem performance so that UK teams can model complex fusion systems faster and with greater confidence, while contributing to widely used international software foundations.
- Finally, the collaboration with Johannes Kepler University (JKU) and Emmi AI in Austria developed proof-of-concept machine-learning surrogate models, trained on large gyrokinetic turbulence datasets, that reproduce expensive core plasma simulation outputs in seconds rather than hours or days. This enables rapid scenario exploration, speeded up design loops, and improved efficiency of experimental time.

> "We love scientific challenges, and building AI models that accelerate 5D gyrokinetic simulations is definitely one of the toughest challenges out there."
>
> **Johannes Brandstetter, Professor at JKU, Co-Founder and Chief Scientist**



[A fusion plasma simulation embedded into UKAEA's MAST Upgrade machine.]

OBJECTIVE 2: To enable the UK to maintain its global technical lead in fusion through the delivery of domestic capabilities.

Building domestic capabilities is crucial for the UK to remain at the forefront of the quest for fusion energy. Fusion Futures has accomplished this in multiple ways over the past two years, including through one of UKAEA's flagship programmes, LIBRTI.

Demonstrating power plant relevant fusion fuel technologies

LIBRTI is adapting a dedicated building at Culham Campus to house a full engineering scale testbed for breeder blanket prototypes. A civils contract of £34.1m was awarded to McLaughlin and Harvey Ltd for the design and build in February 2026. In addition to this, a 14 MeV deuterium tritium neutron generator from SHINE Technologies has been procured and is scheduled for delivery in 2028. This will produce fusion-like neutron spectra for validating breeding materials and configurations.

LIBRTI has already facilitated 11 major experimental and digital simulation projects with UK universities and industry. These cover tritium breeding science, materials behaviour, and high-fidelity digital modelling. Multiple cutting-edge breeder concepts (liquid lithium, PbLi, FLiBe, lithium ceramics) are being modelled and evaluated through LIBRTI supported research. LIBRTI has also hosted the first international Conference on Breeder Blanket Technology, bringing together global experts for knowledge exchange and showcasing progress on the testbed.

LIBRTI hosts first international conference


LIBRTI facility

KEY STATS

LIBRTI
£8M provided to 11 experimental and digital simulation projects.

Technology Transfer Hub
1 joint venture announced.
36 innovation projects started.
2 spinout companies created.
11 open-source software licences issued.
Three software trial licences.

FOSTER
CDT £9 million funding across four years (March 2025-March 2030).
22 students commenced studies at the end of September 2025.

Building hands-on tritium expertise

In addition to this, the **Industry Capability** programme has enabled the UK supply chain to gain rare, hands-on experience in the decommissioning of tritium-contaminated assets – expertise essential for licensing and operating future fusion power plants. Recognising the limited national experience in tritium waste management, UKAEA formed a collaboration to plan and execute the decommissioning of some of the largest and most contaminated tritium-bearing assets, namely AGHS, on the Culham Campus site. The project has allowed for demonstrating best-practice approaches that will inform future fusion plant decommissioning strategies and has created a stronger, more experienced UK supply chain, better positioning the UK to lead globally in safe tritium management and fusion decommissioning.

Growing UK skills to doctoral level

Meanwhile, the **FOSTER** programme has cleared a path to enhance domestic capabilities through training and education, from primary school education upwards.

For instance, the Primary Engineer Partnership has forged direct connections between UKAEA and primary school classrooms, through in-person visits, webinars and grading days, while teachers' conferences and workshops have developed broad engagement with schools by producing education material across multiple levels, targeting outreach to teachers.

A Schools outreach programme has also been developed, including events such as New Scientist Live.

FOSTER has also created the Fusion Engineering Centre for Doctoral Training (CDT), a new centre for doctoral training, led by the Universities of Manchester, Sheffield, Liverpool and Birmingham. With a focus on advanced problem-solving, the CDT's specialist training programme will balance theoretical, practical, and computational training in academic and industrial settings, spanning the entire fusion engineering lifecycle.

Growing digital capability via international partnerships

The **International Computing** programme has targeted collaborations to enhance domestic capabilities. For instance, the collaboration with STFC Hartree Centre and IBM has advanced UK-owned digital capability and helped embed key AI methods into reusable UK processes rather than one-off demonstrations.

Another example is the collaboration with ENI, which has strengthened UK delivery capability by bringing an industry lens into technical development, helping UK teams produce more decision-ready outputs and build the domestic systems and engineering capability needed to lead internationally.

Powering UK prosperity – from innovation to commercialisation

Also critical to developing domestic technical capability is technology transfer from fusion into adjacent sectors. The **Technology Transfer Hub** programme has enabled the spinout of advanced technology capabilities from UKAEA. One such example is MuWave, a recent spinout which offers commercial high-power microwave technology enabled by expertise within the organisation. MuWave will develop the next generation of microwave sources, called gyrotrons, and support global exports.

A second example of the work of the Technology Transfer Hub programme is Simvue, a potential deep-tech UKAEA spin-out transforming how complex simulations and workflows are managed, executed, and governed. Built on expertise from high-performance scientific computing and digital engineering environments, Simvue streamlines simulation workflows across fusion energy, fire safety engineering, climate modelling, aerospace, and advanced manufacturing.

The platform is strategically important to fusion programmes such as STEP fusion, enabling traceability, reproducibility, and optimisation of large-scale simulation campaigns. Simvue is currently running trials with international research laboratories across Europe and multi-billion-pound engineering firms in fire safety and building design, with growing interest in climate modelling and large-scale health data analysis using machine learning.

The MuWave spinout aligns with UKAEA's strategy to translate fusion research into commercial opportunities, driving long-term economic and industrial gain from national R&D investments.

OBJECTIVE 3: to create a strong UK industrial sector that leads the world in operationalising and commercialising fusion energy.

To complement the research and technical excellence advanced by the Fusion Futures programme, an additional objective has been to increase the capacity and capability of the UK industrial sector, building the supply chain needed for future commercial fusion energy.

Growing capability in five key technologies

The **Industry Capability** programme has aided this effort across key technological themes that will be required for future fusion power plants, such as fuel cycle, magnet technologies, plasma measurement and control, remote handling and liquid metals.

Remote handling

One example of this is in the repair & inspection for in-vessel components project carried out by RACE (Remote Applications in Challenging Environments).

The RACE project involves the identification and development of advanced in-situ repair and inspection technologies for fusion reactor vessels – an area previously dominated by a small number of national laboratories. Through targeted market analysis, four repair and two inspection technologies were selected for development, generating new UK-based research and influencing future power plant design. The project catalysed valuable collaborations between specialist SMEs and major institutions such as the Henry Royce Institute, leading to shared trials, NDA agreements, and innovation with applications beyond fusion. Suppliers retained their IP, with UKAEA securing a non-exclusive licence, and several micro-SMEs enhanced their products and market position as a direct result, strengthening the UK's capability and confidence in this critical area of fusion technology.

Liquid metal loop

As breeder blanket development has historically been confined to national laboratories, the UK supply chain had little or no experience in designing and delivering such complex systems. To bridge this gap, UKAEA commissioned the design and construction of the UK's first pilot-scale liquid metal loop. This effort brought together a UK engineering consultancy and two specialist manufacturers, forming a new commercial partnership that blends established engineering excellence with fusion-specific expertise.

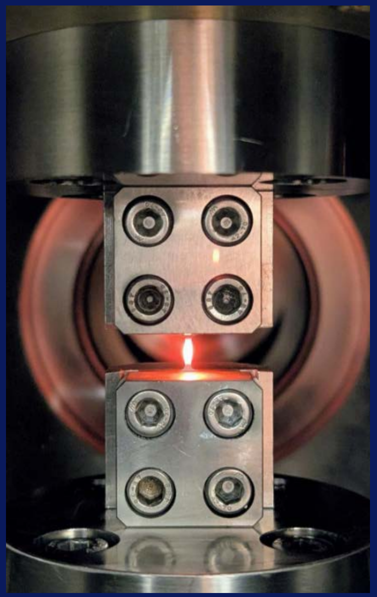
The project has delivered a design meeting the demanding requirements of multiple stringent design codes, despite the challenges posed by highly corrosive, toxic, explosive liquids with densities eight times that of water. The suppliers rapidly adapted to UKAEA's technical standards – standards that are expected to shape future fusion industry norms – significantly improving their competitiveness for future fusion contracts. The resulting pilot liquid metal loop will enable UK companies to test and validate technologies essential for breeder blanket commercialisation. This initiative has not only created new industrial capability but has also embedded fusion-relevant skills within the UK supply chain, positioning the UK to lead globally in the operationalisation and commercialisation of fusion energy.

KEY STATS

Industry Capability
£7.3M to SMEs.
Over 80% spend in industry in 2025/26.
Over 400 contracts delivered.
40% delivered by SMEs in 2025/26.
150+ suppliers engaged.

Materials manufacture

Fusion Futures has strengthened the UK's essential fusion industrial capability by advancing the manufacture and joining of Oxide Dispersion Strengthened (ODS) steels—materials critical for future high-performance fusion power systems. Recognising the challenge of producing and bonding complex ODS components with internal cooling features, UKAEA commissioned two focused development programmes with a highly specialised SME using advanced HIPing techniques and sacrificial inserts, supported by their subcontractor network and collaboration with the Henry Royce Institute. This initiative has already delivered a world first: the successful creation of highly complex near-net-shape ODS components.



Materials testing at extreme temperatures

KEY STATS

FOSTER

Cohort 1

- 2024 start (9 PhDs).
- Industry partners: Frazer-Nash.
- Consultancy, Oxford Sigma Technologies Ltd, STFC, and Tokamak Energy.
- UKAEA contribution: £360k; industry/university contribution: £727.3k.

Cohort 2

- 2025 start (8 PhDs).
- Industry partners: Cavendish Nuclear, digiLab, Frazer-Nash Consultancy, Kyoto Fusioneering, Oxtord Sigma Technologies Ltd, and Tokamak Energy.
- UKAEA contribution: £320k; industry/university contribution: £706.5k.

Materials testing

The **Industry Capability** programme also commissioned a project to address a critical technology gap in materials testing at extreme temperatures under vacuum – conditions essential for qualifying materials for commercial fusion power plants. By mobilising Severn Thermal Solutions, a world-leading UK specialist, UKAEA enabled the development of novel, industry-ready induction and direct-resistance heating systems that deliver advanced mechanical testing with integrated diagnostics. These modular solutions will soon provide UK industry with the ability to test and qualify materials in environments previously unreachable by commercial equipment, benefiting not only fusion but also fission, aerospace, defence, space, and additive manufacturing sectors. Severn Thermal Solutions retains full design IP, positioning them to deploy the technology across multiple industries and helping build a robust UK materials-qualification ecosystem. A technology demonstrator will be installed at an industrial testing centre, maximising visibility and accelerating adoption of this breakthrough capability.

Stimulating the supply chain

Meanwhile, the **Fusion Industry Programme** supported a record 59 challenge scheme contracts, totalling £26m. The programme provides direct financial support to the UK fusion industry, aiming to accelerate the development of early-stage, fusion-relevant technologies. The programme aims to stimulate the current supply chain, attract new entrants from aligned sectors and support businesses of all sizes.

The programme collaborated with technical experts from Tokamak Energy, First Light Fusion and the Science and Technology Facilities Council (STFC), to shape the scope and provide ongoing oversight on two of the challenges.

The challenge titles were Hydrogen Isotopes & Digital Materials, Manufacturing, Heating & Cooling, Lithium, Pulsed Power, Resilient Sensing Technologies, Novel Shielding Materials and Technologies and Hydrogen Isotopes.

Training the industry leaders of the future

Finally, **FOSTER** is contributing to the development of a strong UK industrial sector by stimulating increased engagement from the fusion industry in initiatives that deepen but also diversify and widen access to fusion careers. The Fusion Industry PhD Programme ensures alignment between research and industry, whilst the Cumbrian Robotics Operational Skills Centre (CROSS) focuses on upskilling existing and new entrants to the sector in new technology. CROSS is a new centre of excellence which will see its first full cohort of 200 apprentices from Sellafield starting in September 2026. It has already successfully delivered a pilot of 14 apprentices.

Looking ahead...

Fusion Futures has helped to move the UK closer to commercial fusion energy. It has strengthened sovereign research capability, embedded industrial competence, built international influence, and accelerated innovation.

The objectives of Fusion Futures remain critical for the delivery of UKAEA's fusion ambitions in line with the recently released UK Fusion Strategy. The next phase of the portfolio will:

- Accelerate efforts towards completion and exploitation of the LIBRTI facility;
- Progress technology transfer and commercialisation opportunities from across UKAEA's activities;
- Bring forward new opportunities to grow supply chain capability in specific areas of fusion technology;
- Continue to grow a UK pipeline of fusion skills across the sector through the FOSTER programme.

The UK Atomic Energy Authority's mission is to lead the delivery of sustainable fusion energy to maximise scientific and UK economic benefit

UK Atomic Energy Authority

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