UK Atomic Energy Authority

# Strategy 2026-2030

This document represents the first strategy for the UK Atomic Energy Authority (UKAEA) since its subsidiary company UK Fusion Energy Ltd (UKFE) was set up in 2024 (as UK Industrial Fusion Solutions Ltd) and the remainder of UKAEA's fusion research activities were considered to constitute UKAEA's National Fusion Laboratory. This strategy has been published alongside UKFE's first strategy.

Global interest in fusion as a transformative source of low carbon, secure energy in the future continues to increase. In that context, UKAEA would welcome thoughts and ideas from partners in the UK and around the world on this new approach to its strategy.

# CONTENTS


**1 FUSION AT A GLANCE** **4**

**2 OUR PAST** **6**

**3 OUR PRESENT** **7**

3.1 Context 7

3.2 The UK's Fusion Strategy 2026 7

3.3 UKAEA Group: UKAEA's National Fusion Laboratory and UK Fusion Energy Ltd 8

**4 OUR FUTURE: The STRATEGY OF UKAEA's National Fusion Laboratory** **12**

4.1 Addressing fusion's challenges 12

4.2 Four Strategic Themes: International, Research, Commercialisation, Industry 19

4.3 Place 26

4.4 People 28

4.5 Delivery 2026-2030 30

4.6 Impact 38

4.7 Progress and Potential 42

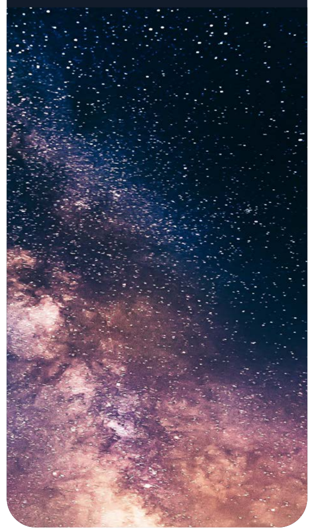
**5 YOUR VIEWS** **46**

# 1 Fusion energy at a glance

**UKAEA leads the world in fusion research with a wide range of programmes covering plasma science, robotics, materials testing and development, and tritium science. Our scientists and engineers are working with partners in the UK and around the globe to develop fusion as a new source of clean energy for tomorrow's power plants.**

## WHAT IS FUSION?

Fusion takes place in the hearts of stars and provides the power that drives the universe.

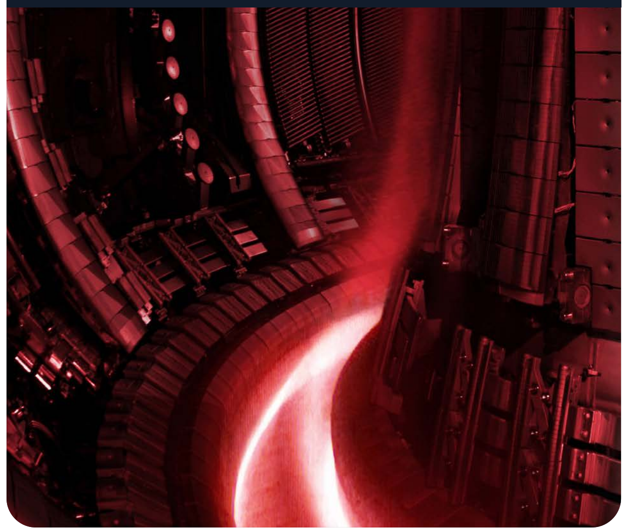


Our scientists and engineers are working with partners in the UK and around the globe – developing the technology to sustain this process on Earth to create a new source of sustainable energy.

## HOW DOES IT WORK?


Fusion energy can be generated in a variety of ways, with UKAEA focused on Magnetic Confinement Fusion (MCF).

Energy is released when the lighter deuterium and tritium atoms fuse together to form a heavier helium atom and a neutron.





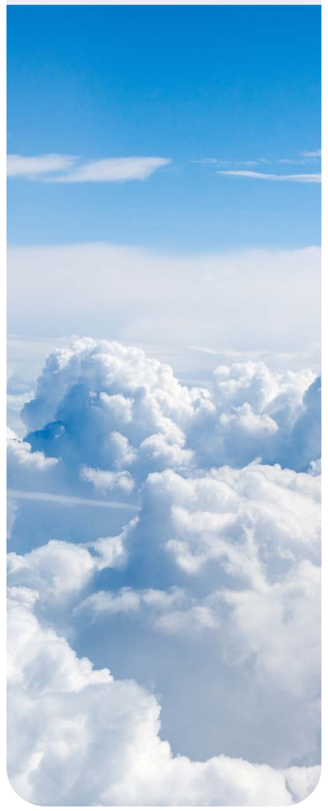
## BENEFITS OF FUSION

### Low carbon

Fusion energy is carbon-free at the point of generation.

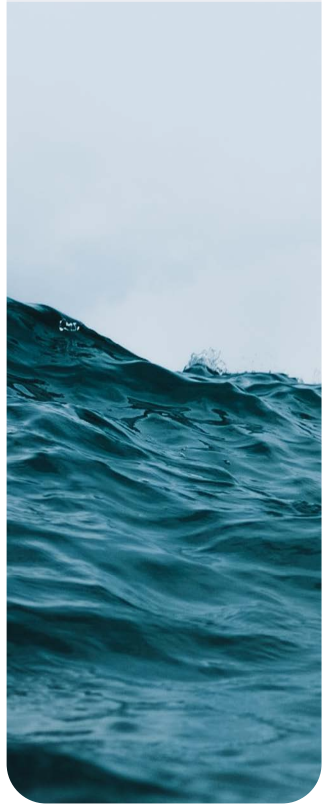
### Continuous

Fusion energy is continuously deployable, as it does not depend on external factors such as wind or sun.



### Sustainable

Fusion fuel is abundant in our seas and the Earth's crust.



### High fuel efficiency

Fusion produces more energy per gram of fuel than any other process that could be achieved on Earth.

# 2 Our past

## Historical context and key changes

**1920s**

Arthur Eddington suggests that stars draw their energy from the fusion of hydrogen into helium.

**1930s**

Rutherford and Oliphant at the University of Cambridge show the fusion of deuterium into helium and observe that "an enormous effect was produced".

**1940-50s**

Researchers start looking at possibilities of replicating the process of fusion on Earth. UKAEA starts the ZETA experiment in 1957.

**1960s**

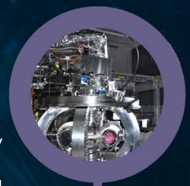
Culham Laboratory in Oxfordshire opens. Lev Artsimovich from the USSR presents results at the 1965 IAEA conference at Culham describing encouraging results from a device called a tokamak-many magnetic confinement fusion devices are now based on this design.

**1970s-80s**

Small tokamak devices were then built at Culham such as TOSCA. European countries came together to design and build JET at Culham.

**1990s**

JET sets 1st world records and the Culham laboratory operates the first full-sized spherical tokamak, START, followed by MAST.



**2000s**

Several privately backed fusion companies launch.

## In the last decade

**August 2014**

The RACE centre of excellence opened with the building following in 2016. RACE collaborates internationally to design, operate and deliver robotics for extreme environments.

**May 2016**

The Materials Research Facility (MRF) opens, enabling industrial and academic researchers to analyse the effects of irradiation on materials.

**October 2019**

The conceptual design phase for STEP, a prototype fusion power plant, begins.

The Oxford Advanced Skills (OAS) centre opens on Culham Campus aiming to train up to 350 apprentices each year.

**October 2020**

The Fusion Technology Facility (FTF) in South Yorkshire opens, our first new research site outside of Culham since the 1950s, bringing highly skilled jobs, fostering collaborations with research organisations and engaging industry.

**October 2020**

MAST Upgrade starts operation with the engineering team achieving the Royal Academy Major Project Award. The upgrade introduced an innovative new plasma exhaust system, longer pulses, increased heating power and a stronger magnetic field.

**May 2021**

A second JET campaign using the fuel mixture of deuterium and tritium begins.

**April 2022**

The RAICo Programme Collaboration launches, using robotics and AI in nuclear decommissioning environments.

**June 2022**

Tritium research centre (H3AT) opens at Culham to lead the delivery of tritium lifecycle solutions and technology both in fusion and adjacent sectors.

**October 2022**

West Burton site announced as the future home of STEP. It will create thousands of highly skilled jobs in the area and attract high-tech industries.

**December 2023**

JET runs its last pulse (having achieved a world record in October) and starts repurposing and decommissioning.

**November 2024**

UKIFS Ltd is stood up as a subsidiary company of UKAEA to deliver the STEP programme and stimulate growth of a UK fusion energy industry. UKIFS Ltd was renamed UK Fusion Energy Ltd in March 2026.

**March 2025**

The partnership between UKAEA and Eni S.p.A is launched, to work on the world's largest and most advanced tritium fuel cycle facility in the UK.



RETURN TO CONTENTS

# 3 Our present

## 3.1 Context

The world needs to accelerate large-scale clean energy provision in order to meet growing demand and to build resilience to climate change and challenges to energy security. This drives a global imperative to explore all credible options for clean energy supply, both to meet net zero commitments and to sustain clean energy generation beyond 2050. Renewables and nuclear fission have an important role alongside other low carbon solutions but alone may not provide sufficient resilience or suit all energy markets around the world. Fusion energy represents a potentially advantageous clean energy solution in future global energy markets, as both a source of base load electricity and for wider industrial application.

There have been promising advances in fusion in recent years, driven by:

- Technical developments in fusion research, development and innovation (RDI)[1] and in enabling manufacturing and computing capabilities;
- The urgent need to decarbonise global energy production;
- An increased understanding of the economic benefits arising in the short-term from fusion RDI activities and in the long-term when commercially relevant fusion energy is deployed.

These advances are supporting significant increases in government and private investment into fusion around the world. Japan[2], Canada[3] and Germany[4] are developing or having published national strategies, the latter with €2bn of additional investment. China is estimated to have invested $6.5bn between 2023-2025 in advanced fusion research facilities and technologies[5].

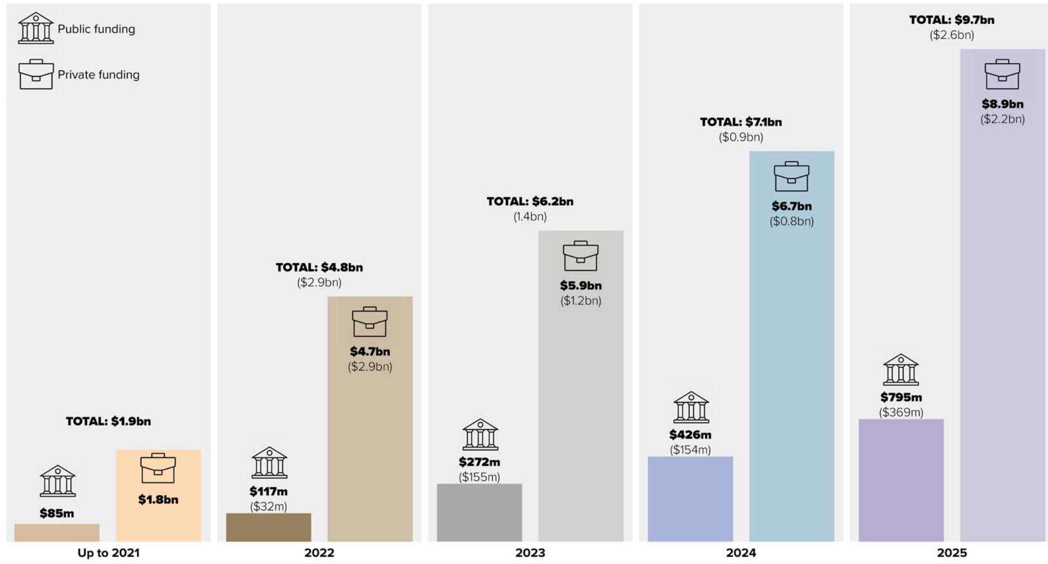



**Figure 1 - Funding raised by fusion companies by 2025, by funding source. Source: Fusion Industry Association.**

Fusion companies raised a total of $2.64 billion in the 12 months leading to July 2025. Total funding for 53 fusion companies stands at $9.766 billion, a five-fold increase since 2021.

Despite this increase in commercial investment and the successes of publicly and privately funded fusion projects, the deployment of commercially relevant fusion energy into future energy markets is expected to face persistent technical and deployment challenges that are likely to require coordinated government intervention to overcome[6].

[1] The term RDI is used throughout this document, consistent with broader UK Government policy on science and innovation.
[2] Japan Unveils Updated National Fusion Energy Strategy - Fusion Industry Association
[3] CNL announces new programs to position Canada to seize opportunities in fusion energy - Canadian Nuclear Laboratories
[4] Germany Unveils "Fusion Action Plan" - Fusion Industry Association
[5] Fusion Energy - SCSP
[6] The breadth and depth of the technical challenges to deploying commercial fusion energy plants – combining specialist scientific expertise, manufacturing and fabrication of novel components and systems, integrated design and infrastructure construction – is judged to be beyond the capability of any single organisation currently in existence. On top of this is the challenge to industry and regulators in developing and substantiating a technically viable integrated plant at an acceptable cost in an uncertain energy market. Managing these risks and uncertainties will likely require long-term commitment by governments and/or other sources of significant funding.

## 3.2 The UK's Fusion Strategy 2026


It is in this context that the UK Government has recognised the opportunity for the UK to leverage its current position as a leader in fusion research and its enabling regulatory and planning frameworks in order to target a meaningful share of a future fusion energy market. In 2025 the UK Government confirmed a record £2.5 billion budget commitment for fusion RDI for the five-year period to 2030, as part of its **Industrial Strategy**.


In March 2026 the UK Government published a revised **UK Fusion Strategy**. This articulates the Government's objective for fusion: "to accelerate growth of the UK fusion industry to capture the economic and strategic benefits of fusion". The UK Fusion Strategy emphasises focused effort in areas in which the UK has distinctive strengths while continuing to collaborate internationally to share knowledge and access valuable capabilities. The UK Fusion Strategy makes clear that at the heart of this national endeavour is the **UK Atomic Energy Authority**.

## 3.3 UKAEA Group:

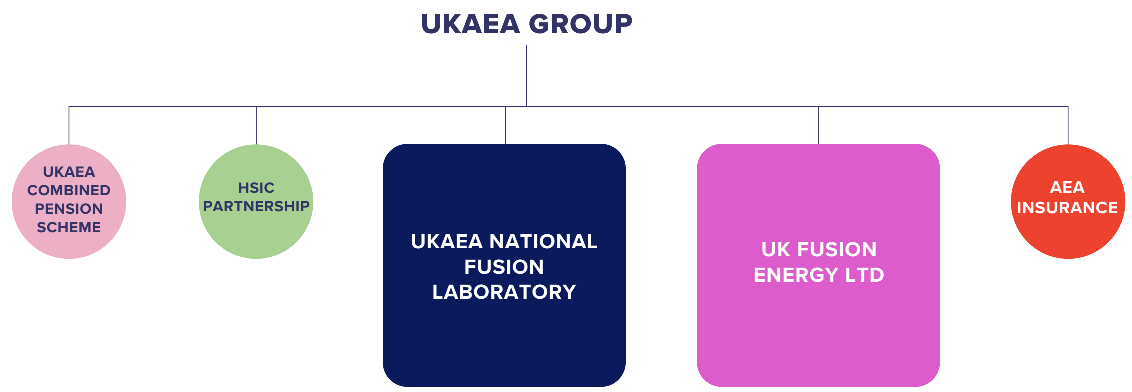
## UKAEA's National Fusion Laboratory and UK Fusion Energy Ltd

### 3.3.1 Who are we?


The UK Atomic Energy Authority (UKAEA) celebrated its 70th anniversary in 2024. With a workforce of 2,600, UKAEA is the largest, most experienced single fusion organisation in the world. Between 1983 and 2023, UKAEA operated the Joint European Torus (JET)[7], the most successful fusion energy facility to date. JET was the first fusion machine to operate using a fuel mix of 50-50 tritium and deuterium, which is crucial for future fusion power plants and to achieve predictable high-power performance, culminating in its record-breaking levels of fusion energy production in 2023[8]. Over 40 years, JET was integral to building understanding in fusion science and technology, both globally and in the UK, where UKAEA developed facilities dedicated to specific fusion technologies, such as **robotics**, **materials research** and **fuel systems** alongside the long-standing **plasma science** programmes. UKAEA's work was also strongly informed by its close involvement with the **ITER** and **EU DEMO** projects[9].

UKAEA published its last strategy in 2022. The establishment in November 2024 of UK Industrial Fusion Solutions Ltd (UKIFS) as a subsidiary company of UKAEA represented a critical milestone in the evolution of UKAEA. From this point, UKAEA considered itself effectively to be a corporate group, "UKAEA Group". In March 2026 UKIFS was renamed **UK Fusion Energy** Ltd (UKFE). This name reflects the organisation's progress in building and leading an industrial team to deliver **STEP** and successive fusion power plants by acting as a national fusion systems integrator. Other fusion research, development and innovation activities within UKAEA Group are collectively considered to comprise the UKAEA's National Fusion Laboratory[10].

[7] The Joint European Torus (JET) was the focal point of the European fusion research programme for 40 years: https://www.ukaea.org/news/jet-set-for-its-40th-birthday/ The UK was previously a member of Euratom Research and Training (Euratom R&T) and Fusion for Energy (F4E). Through the UK's membership of F4E, it could also access ITER, a power-plant scale fusion experiment under construction in France. EU membership also enabled UK involved in the EU DEMO. When the UK left the EU, it also left these programmes. Since then, the UK Government has increased support for the UK fusion programme.
[8] JET generated 69 Megajoules of energy over a 5 second period. JET's final tritium experiments yield new fusion energy record - GOV.UK
[9] See footnote 11.
[10] UKAEA's National Fusion Laboratory is not a legally separate entity from UKAEA Group, though it is increasingly distinct in terms of governance and operations.




- UKAEA Combined Pension Scheme: UKAEA is responsible for the management of the Combined Pension Scheme (CPS) and related pension schemes, which are for eligible UKAEA employees and other participating employers.
- HSIC Partnership: UKAEA Group has 50% control of a joint Public Sector Limited Partnership (HSIC PubSP), the public-sector partner in Harwell Science and Innovation Campus Ltd Partnership (HSIC), which is responsible for the development of the Harwell Campus.
- UK Fusion Energy Ltd
- UKAEA's National Fusion Laboratory
- AEA Insurance Ltd: 100% UKAEA-owned subsidiary currently utilised for paying historic employment claims.

**Figure 2 - Summary illustration of UKAEA Group.**

### 3.3.2 How is UKAEA Group responding to the UK Government Strategy?

Delivering on the Government's vision depends upon bringing together the experience and capacity of UK industry with the expertise of UKAEA to develop capability and solutions through the practical design and delivery of a pilot fusion power plant. This rationale is the basis of UK Fusion Energy (UKFE), which will partner with UKAEA's National Fusion Laboratory and industry to develop the fusion technologies and capabilities required for STEP and successive power plants. This is detailed further in the new **UKFE Strategy**.

At the same time, the depth of fusion's technical challenges, the breadth of near-term adjacent scientific and economic opportunities, and the enduring importance of a sovereign RDI capability in maintaining competitiveness in a strategically critical future technology underline the importance of a national RDI function, as distinct from UKFE and its partners. This is the basis of UKAEA's National Fusion Laboratory and its strategy, as described in Section 4.

### 3.3.3 Our mission and goals

The UKAEA Group mission has been updated since the publication of the UK Fusion Strategy 2026. The UKAEA Group mission is

> **"To lead the delivery of sustainable fusion energy to maximise scientific and UK economic benefit"**

UKAEA Group has also reviewed its strategic goals to ensure consistency with the UK Fusion Strategy 2026 and their relevance to the roles of UKAEA's National Fusion Laboratory and UKFE towards achieving the single UKAEA Group mission[11]. This is set out in figure 3 overleaf.

The remainder of this document focuses on the strategy of UKAEA's National Fusion Laboratory.

[11] This has identified a new UKFE -specific goal, "to design, deliver and operate fusion power plant", and amended the wording of the previous "product" related goal to broaden scope to fusion power plant and adjacent technologies.

**UKAEA National Fusion Laboratory's role**

Deliver foundational research, technology and innovation in support of the UK fusion sector through world-leading fusion expertise and capability.

# MISSION

To lead the delivery of sustainable fusion energy to maximise scientific and UK economic benefit.

**UK Fusion Energy's role**

Deliver STEP and successive fusion power plants by acting as a national fusion systems integrator and working with industrial partners to develop and deploy the technologies and capabilities required.

## UKAEA GROUP MISSION

**PRODUCT**
Develop technologies for fusion power plant and adjacent sectors.

**PROSPERITY**
Enable a thriving UK fusion industry that exports fusion technology around the world.

**PROBLEMS**
Solve challenges of sustainable fusion energy - from design through to decommissioning - with world-leading science and engineering.

**POWER PLANT**
Design, deliver and operate fusion power plant.

**PEOPLE**
Nurture the talented, diverse people needed to deliver fusion energy.

**PLACE**
Grow clusters that accelerate innovation in fusion and related technologies.

Colour key

- UKAEA primary goal
- UKFE primary goal
- UKAEA and UKFE supporting goals
- Colours correspond to those on the UKAEA portfolio logic model on page 40-41

Figure 3 - UKAEA Group mission and goals, and the roles of UKAEA and UKFE.

# 4 Our future: The STRATEGY OF UKAEA's National Fusion Laboratory

The role of UKAEA's National Fusion Laboratory in the UKAEA Group mission is "to deliver foundational research, technology and innovation in support of the UK fusion sector through world-leading fusion expertise and capability". The remainder of this document describes the strategic approach of UKAEA's National Fusion Laboratory in executing this role via a portfolio of activities. In summary:

- The technical basis of the portfolio – the "what" – is driven by the challenges of fusion and UKAEA's technical strengths (section 4.1);
- The strategic basis of the portfolio – the "why" – is informed by four "themes" of activity – International, Research, Commercialisation and Industry – which are used to frame the scientific and economic benefits that can be achieved via these activities (section 4.2). These activities sit alongside UKAEA's work as the Fusion Partner of UK Fusion Energy Ltd, an arrangement which leverages UKAEA's fusion capabilities to develop fusion-specific technical solutions for the STEP programme;
- The development of places (4.3) and people (4.4) are also core to UKAEA's strategy.

UKAEA has used this approach to commit to a four-year portfolio of activities following the Government's Spending Review settlement for fusion confirmed in 2025 (section 4.5). This portfolio is expected to deliver broader economic impact (4.6). Throughout this section, "UKAEA" will be used to refer to "UKAEA's National Fusion Laboratory", unless otherwise stated.

## 4.1 Addressing fusion's challenges

### 4.1.1 Challenges of fusion

There are challenges in most areas of fusion. The technical challenges have been extensively explored in scientific literature and form the basis for much of the R&D around the world. The challenges vary between fusion concepts and between the intended purpose of any one fusion device and in how they can be addressed. UKAEA considers that there are four interrelated challenges which effectively apply to all mainstream approaches seeking to deploy fusion energy, though figure 4 uses a tokamak to illustrate these.



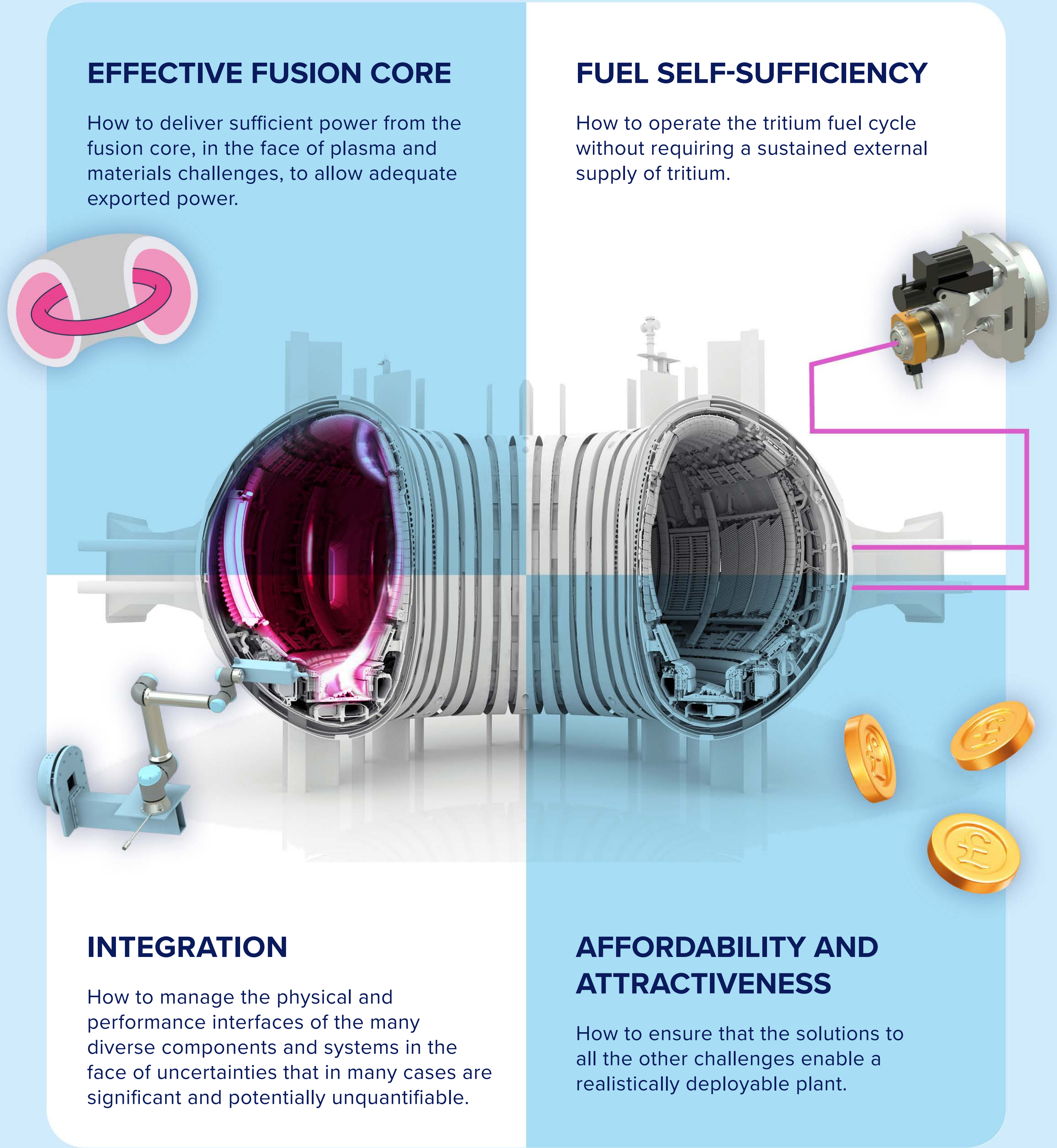



**Figure 4 - The interrelated challenges of fusion.**

The final challenge represents a driver of overall competitiveness, as would be the case for any engineered product or solution. Competitiveness may flow from being able to enhance continually a product's affordability and attractiveness. The breadth and depth of fusion's technical challenges means that a national RDI capability will be needed to underpin long-term national competitiveness in sustainable fusion energy. This final challenge anchors the enduring need for UKAEA, up to, during and beyond the deployment of STEP and successive fusion power plants led by UKFE. It is a key reason for UKAEA (as the National Fusion Laboratory) to act as UKFE's Fusion Partner.

## 4.1.2 The fusion lifecycle

UKAEA's operation of JET and MAST-U, its specialised tritium-capable infrastructure, and its historic and ongoing programmes and collaborations have together generated understanding of and expertise in fusion's challenges as they apply across the lifecycle of a fusion device, from design to decommissioning. With UKAEA as the STEP Fusion Partner, UK Fusion Energy Ltd is working to apply at industrial scale this technical understanding of the fusion lifecycle, in an increasingly commercial context, to deliver STEP and successive fusion power plants.

**Figure 5a - The fusion lifecycle.**

**Design and develop**

A technical understanding and holistic perspective of fusion's challenges is required to identify those conceptual and design factors which materially affect affordability and attractiveness and what research rigs and equipment may or may not be useful in testing these.

**Integrate and Build**

Specialist engineering capabilities and a dynamic organisational model are required to deliver with industry and other partners the test beds and rigs needed for fusion's challenges. This should also be able to appraise the integrability of technical solutions into a full-systems fusion power plant.


**Decommission and reuse**

Technical and organisational capacity is required to decommission and repurpose infrastructure and process wastes promptly and safely and so contribute to fusion's affordability and attractiveness. This applies to developing technical solutions and to informing the relevant regulation and policy frameworks.[12]

**Commission and operate**

Multi-disciplinary operational teams, specialist infrastructure and interrelated theory and simulation capabilities are required to test, develop and operate complex and hazardous fusion research facilities.

Aside from in its work as the STEP Fusion Partner, UKAEA applies this understanding primarily in the context of fusion-specific or focused research facilities (such as MAST-U, LIBRTI or the H3AT Tritium Loop). In doing so, its approach is to harness the required technical capabilities through partnering arrangements and collaborations with UK industry as far as possible. Where this does not exist or cannot be developed in UK industry, UKAEA will seek to sustain its own critical mass of the fusion-specific capabilities and the necessary cross-cutting engineering, design, computing and operational capabilities, alongside its specialist enabling infrastructure. Even after the deployment of prototype and early generation fusion power plants, there will be an ongoing need for such facilities and test rigs to enhance continually the affordability and attractiveness of fusion. This aligns strongly to UKAEA's enduring research role.

[12] Doing so is a key learning from fission, whose "attractiveness and affordability" did not originally consider the costs of decommissioning, and where innovative solutions to address this have been historically under-appreciated and thus under-funded. Moreover, it is essential to understand the technical background to the hazards and risks that are at the core of regulation and applicable policy frameworks if this is to be genuinely proportionate in its philosophy and application. Supporting the Government on this represents another key enduring role for UKAEA. This topic has been recently explored by the Government's response to the Nuclear Regulatory Review 2025.
[Building our nuclear nation: government response to the Nuclear Regulatory Review 2025 (accessible webpage) - GOV.UK]

Through all stages specialist computing capabilities are required.

Across the entire lifecycle, these computing capabilities allow UKAEA to design smarter, build faster, operate safer and decommission more responsibly.

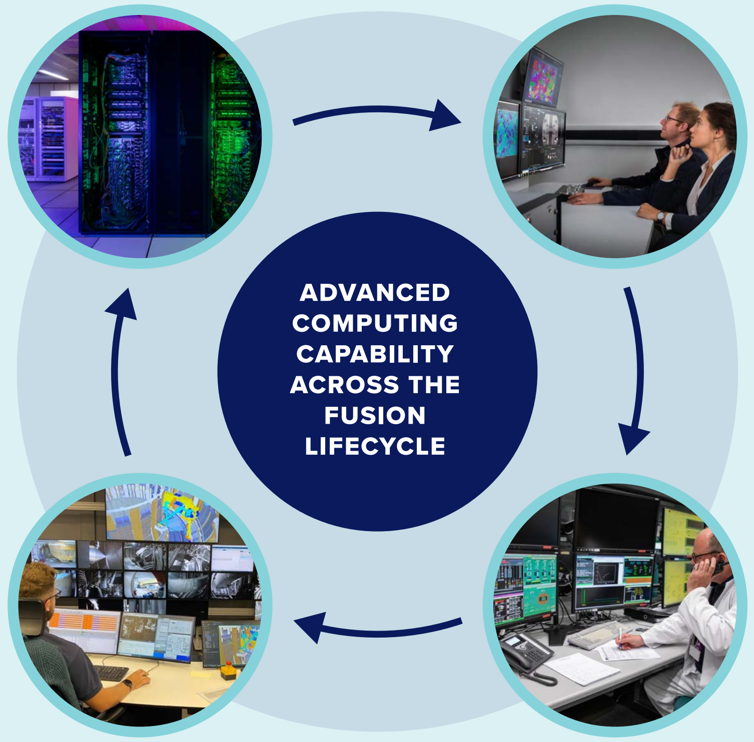
**Figure 5b - The fusion lifecycle 'in-silico'.**

**Design and develop**

Advanced computing enables UKAEA to understand fusion's challenges and design solutions across the lifecycle of fusion, with the new Sunrise supercomputer representing a strategic UK AI capability focused on fusion. Sunrise, along with UKAEA's broader computing capabilities, will allow for early design concepts to be tested virtually and appraise where physical investment, such as in research rigs, is most needed.

**Integrate and Build**

As designs progress, high-fidelity digital twins open opportunities for UKAEA, UKFE and industry partners to integrate new components, control approaches and materials into full plant architectures before construction.




**Decommission and reuse**

At end-of-life, advanced computing ensures responsible decommissioning by preserving long-term digital records, running predictive material and activation models, and providing the knowledge base needed to plan waste handling and repurposing accurately – avoiding the historical under-estimation of decommissioning costs seen in fission.

**Commission and operate**

Once facilities move into operation, advanced computing becomes essential to running complex fusion facilities safely and efficiently. Real-time data processing, simulation-backed forecasting and intelligent control tools strengthen operational decision-making and allow more ambitious experimental scenarios. Digital twins for fusion research facilities will support scenario exploration and provide rapid evidence for operations, assurance and safety cases.

## 4.1.3 Technical areas

It is also helpful to consider the challenges of fusion in terms of how they relate to more discrete technical areas. This is broadly the basis on which UKAEA has been organisationally structured in recent years, where technical strengths in tokamak-based fusion anchor organisational divisions.

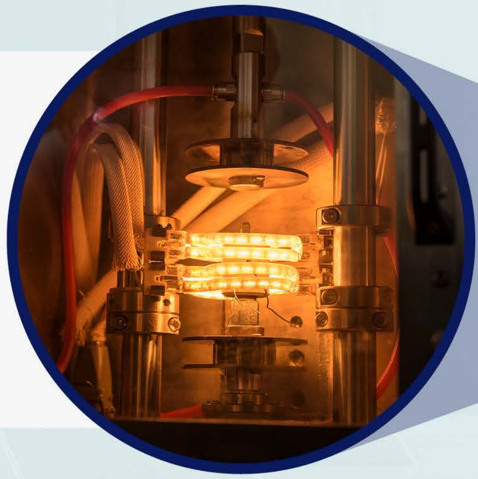
From the two interrelated challenges of achieving an effective fusion core and fuel self-sufficiency, **three core areas of technical activity** can be identified where UKAEA has particular historic strength.

### PLASMA

Understanding and simulating numerically the fundamental behaviours of confined plasmas and the factors affecting the design, achievement and control of plasmas in fusion plants.

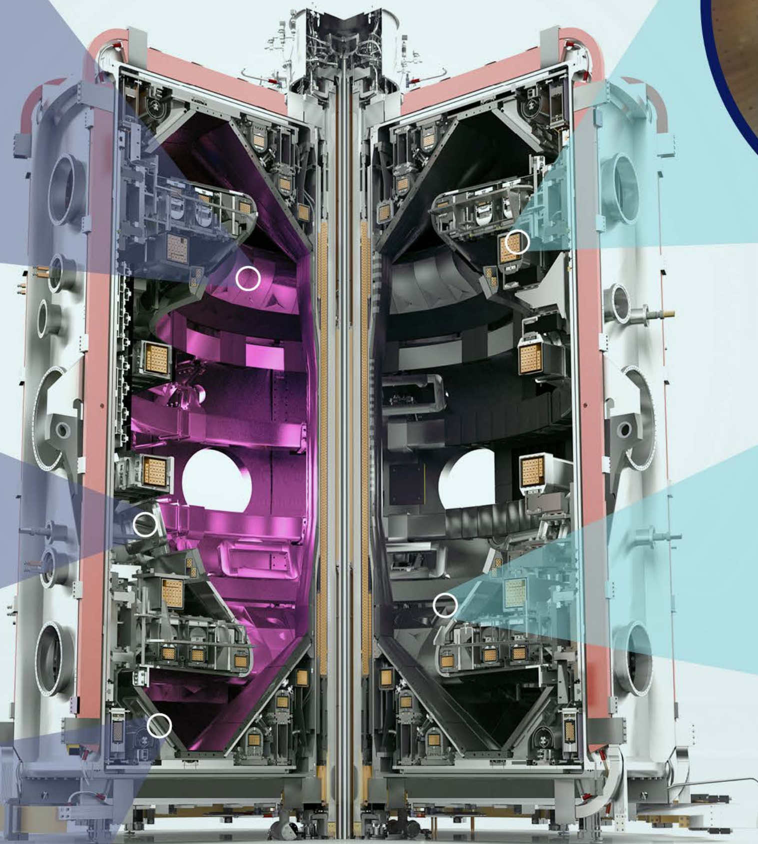
### FUEL CYCLE

Understanding tritium behaviour and developing ex-vessel tritium handling systems and the tritium plant.**



### MATERIALS

Developing materials knowledge and solutions necessary to understand fusion materials and how to use them in principle in multi-material components that can withstand fusion conditions, and how to use neutron-materials reactions to breed new tritium fuel

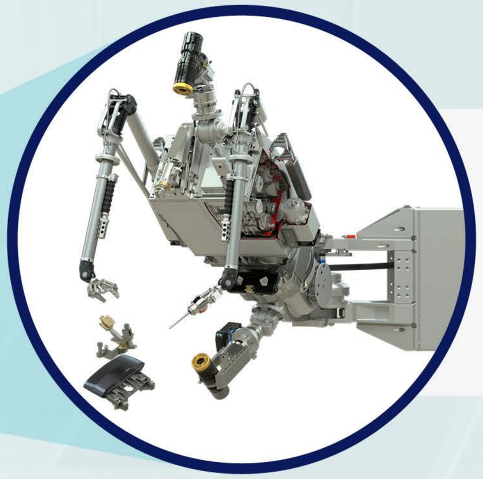


**For the purposes of delineation, this excludes the tritium breeding process and in-vessel materials behaviour, components and systems for which (often known as "blankets") are included in "materials" and "fusion technologies"

**Two further areas of technical activity** considered to be "device-defining" for fusion energy facilities. These cut across some or all of the four interrelated challenges.

### FUSION TECHNOLOGIES

This includes high-temperature superconducting magnets, component qualification tools and neutronics and thermal hydraulics technologies, in the context of fusion.



### ROBOTICS

This refers specifically to automated and autonomous remote operations and maintenance.

**Advanced computing** - This has been identified and acknowledged as a critical technical enabler in each of these individual areas, as well as across each of the 'lifecycle stages' as described in the previous section.

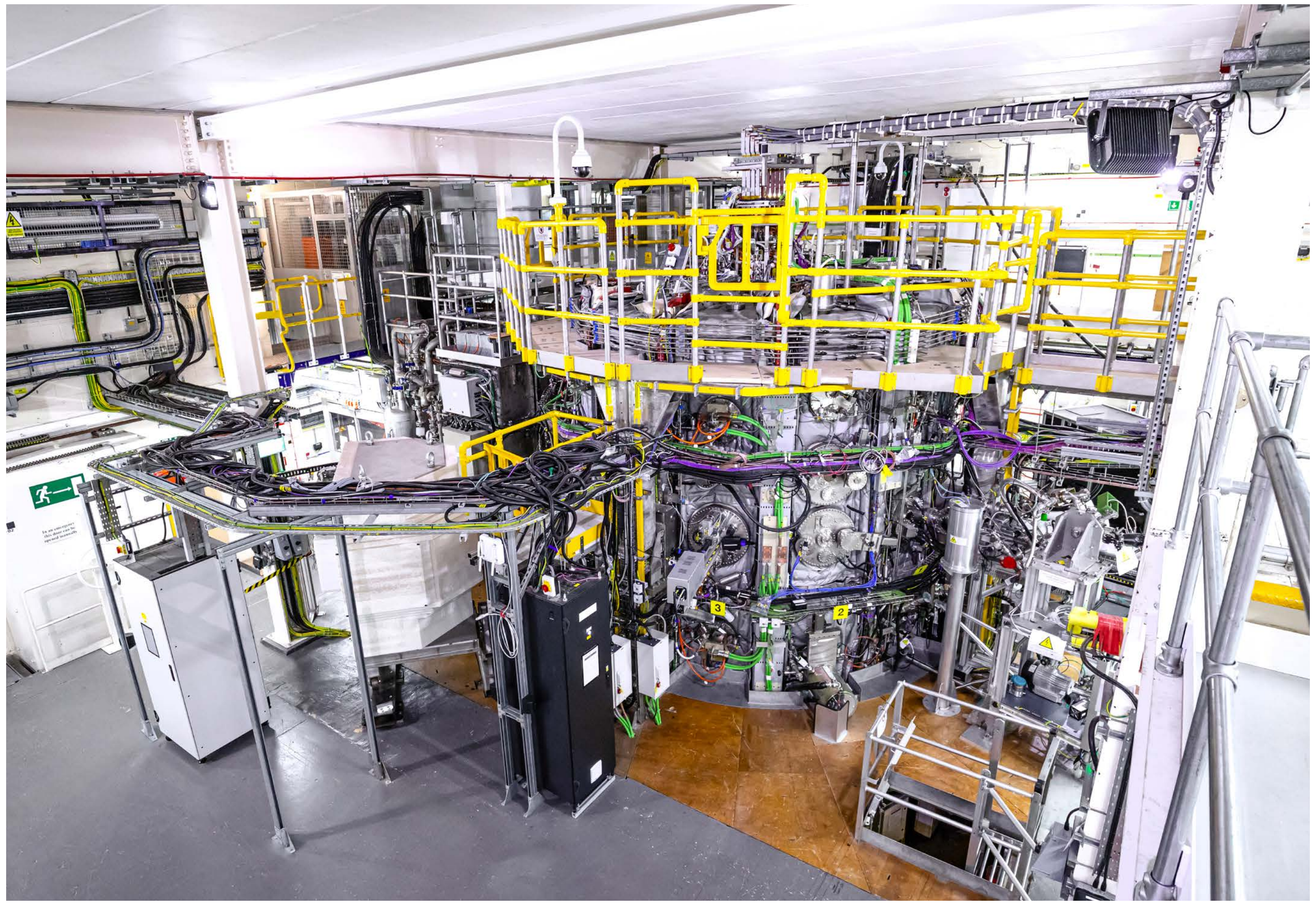
**Fusion-relevant engineering** - A fusion-relevant engineering, design and delivery capability, combined with specialist enabling infrastructure (such as fusion-relevant Health Physics) and understanding of relevant codes and standards, is another critical technical enabler of fusion.



RETURN TO CONTENTS

**Informed by the 2025 Spending Review, this strategy confirms that UKAEA will:**

- Complete and operate major new fusion research facilities, most notably H3AT and LIBRTI, and other critical research rigs and laboratories;
- Increase investment in the operational infrastructure of MAST-U as the UK's premier fusion facility;
- Maintain its fusion enabling infrastructure in line with operational criticality and affordability;
- Continue to decommission JET in a way that maximises scope for infrastructure repurposing and innovation and helps to define requirements for future fusion power plant decommissioning, to a timetable subject to affordability;
- Consider what future fusion research facilities may be developed in future years;
- Work with UK and global partners and collaborators to exploit the Sunrise AI supercomputer and other computing facilities, to deliver on the Government's Culham AI Growth Zone initiative.



## 4.2 Four Strategic Themes: International, Research, Commercialisation, Industry

Section 4.1 set out the technical basis of the scope of UKAEA's portfolio of activities. This section describes the strategic basis, whereby four "themes" of activity – International, Research, Commercialisation and Industry – are used to frame the scientific and economic benefits that can be achieved via these activities, and to help identify how activities correspond to the UKAEA goals. The themes broadly align with the three elements of Research, Development and Innovation (RDI). All are dependent on UKAEA's enabling facilities, infrastructure and the wider UK fusion skills base[13].

UKAEA is the Fusion Partner of UK Fusion Energy, and in this role delivers fusion-specialist capability to the STEP programme. This work is not detailed in this strategy, although illustrative deliverables are included in the 'thematic objectives' table in section 4.5, to display how this aligns with UKAEA's wider portfolio.

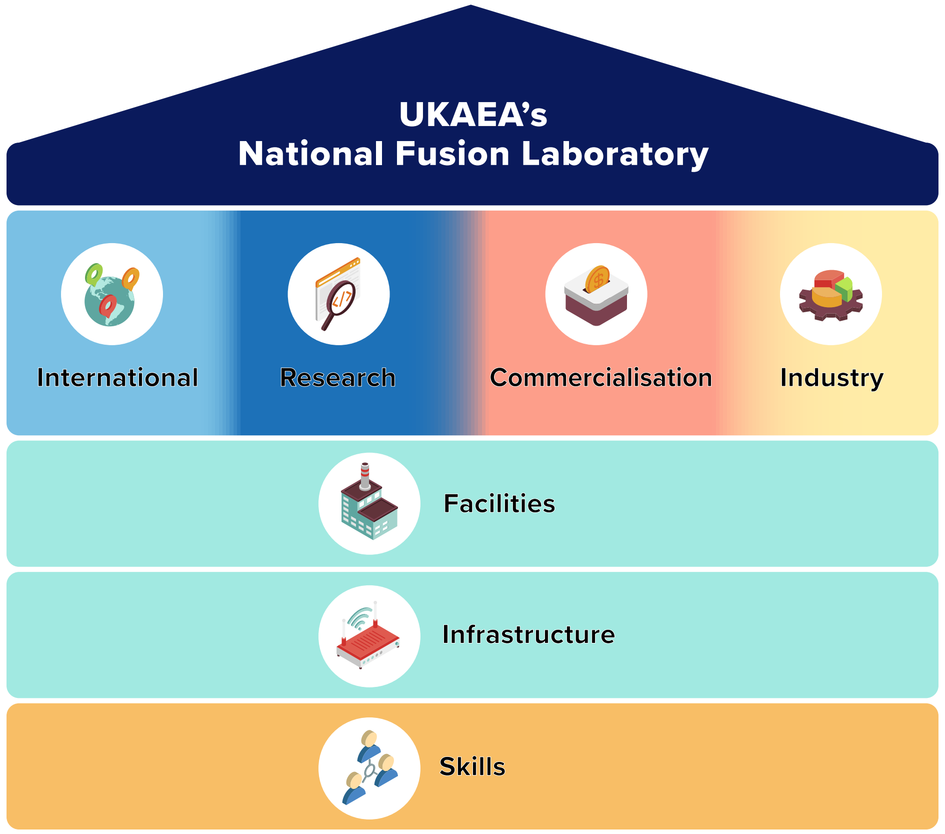



**Figure 6 - Illustration of UKAEA's activities, with colours corresponding to resources in sections 4.5 and 4.6.**

[13] Activities or investment focused primarily on the operation or development of these foundational capabilities, facilities and infrastructure necessarily cut across all of the themes. It should be acknowledged that this delineation is not straightforward in practice, with UKAEA programmes routinely working across more than one of these themes.

## 4.2.1 International

Knowledge and talent are internationally mobile. There are around 70 different nationalities working at UKAEA's Culham campus. International collaborations, particularly with European partners on JET[14], have underpinned UK fusion research over many years. These collaborations build broader understanding, reduce the risks associated with major R&D programmes with long time scales, and the pooling of technical knowledge can unlock the breakthroughs needed. They may also provide opportunities on which then to build distinct sovereign capability. UKAEA maintains partnerships with international laboratories and consortia across Europe, North America, and Asia. These relationships support shared experimental programmes, coordinated modelling and benchmarking, standards development, and joint publications.

**Examples of UKAEA collaborations**

- Collaborations with Oak Ridge National Laboratory and Argonne National Laboratory in the USA span UKAEA's Divisions.
- UKAEA's collaboration with EUROfusion provides a route to extensive collaborations with European partners.
- As well as across Europe and the USA, UKAEA has particularly strong collaborations with Japanese and Korean fusion institutes.

There is increasing competition across the field of fusion, both commercial and international. Commercial competition takes the form of multiple fusion developers, each pursuing their own approach to delivering fusion[15]. State-led competition may take the form of national programmes intended to stimulate national industrial capability. Rather than precluding international collaboration, this competitive environment should provide a renewed imperative to pool resources and support development to mutual advantage.

FUSION INDUSTRY ASSOCIATION

The Fusion Industry Association is a non-profit organisation composed of private companies working to make commercial fusion energy a reality. UKAEA will continue to work closely with the FIA and its members around the world through both collaborative and commercial arrangements. This will help accelerate fusion development and support new investment into private fusion companies while benefitting UKAEA as a global centre of fusion expertise.

[14] UKAEA's research activities historically leveraged funding and access to €bn research facilities from European partners via UK membership of Euratom R&T.
[15] This competition may often centre on specific technologies and their deployment, but less so on the enabling capabilities and background IP involved in fusion, areas which are recognised as the domains of national laboratories such as UKAEA.



This strategy confirms that UKAEA will continue to collaborate internationally in line with the principles of the UK Fusion Strategy, in particular that collaborations should support UK strategic and economic objectives. Through the Fusion Futures programme, UKAEA will continue to prioritise activities that (for example): serve to pool knowledge, capabilities and skills; enable reciprocal access or exploitation of physical and simulation development facilities and data-sets; or coordinate research to increase value for money while protecting UK knowledge assets. Summaries of specific areas of work are set out in the column "Access collaborative international capabilities and opportunities" on page 36-37.

## 4.2.2 Research

This section considers those activities which are primarily research-focused, where outputs include high-impact academic papers, hosting international scientific conferences and growing influence and thought-leadership. These activities are mostly delivered through a collaborative model that spans universities, international research laboratories, and specialist institutes in the UK and overseas. Research programmes are often structured around shared platforms, open tools, and common data frameworks, enabling partners to work together efficiently across organisational and national boundaries to build understanding and knowledge. This approach supports sovereign capability while remaining outward-looking and globally connected.

UKAEA works with a diverse set of universities, with partnerships taking multiple forms, including jointly delivered research projects, co-supervised PhD studentships, postdoctoral research positions, and visiting appointments. Key examples are UKAEA's participation in the Fusion Power CDT centred at York University and the Fusion Engineering CDT centred at Manchester University, where UKAEA also has a formal strategic partnership.

Looking ahead, the scope of UKAEA's research activities is expected to extend to adjacent areas where UKAEA's fusion capabilities offer potential for high-impact science and/or other government research priorities. There may be a renewed emphasis on foundational research undertaken with academia, or supporting product development led by innovative companies, all while maintaining the "mission-driven" character of UKAEA as a clean energy research organisation. This breadth of opportunity spans UKRI's three priorities across RDI:

- **"Curiosity-driven, foundational research"**
- **"Strategic government and societal priorities"**
- **"Supporting innovative companies".**

UKAEA intends to expand both the scale and ambition of its collaborative research activity. By continuing to act as a research convenor, integrator, and longterm partner, UKAEA aims to ensure its research activities remain nationally and internationally connected, and capable of delivering impact well beyond fusion alone.

UKAEA has a long history of working with UK universities and has sponsored academic Chairs and Centres of Doctoral Training across many areas of RDI. This strategy affirms the intention to deepen such research-based relationships against the framework set out in this strategy.

Many of UKAEA's scientists and engineers are global leaders in their fields: talent attracts talent, and is often highly adaptable. UKAEA's scientists and engineers will continue to be encouraged to propose and lead their own projects, working within the broader framework set out in this strategy. UKAEA also welcomes research proposals from external partners.

This strategy confirms that UKAEA will:

- Deliver on planned research activities that provide breadth of understanding and depth of impact across the field of fusion, with summaries of specific areas of work set out in the column "Advance science and secure UK knowledge leadership" on page 36-37;
- Continue to act as a convenor and long term partner in research on fusion and adjacent opportunities, with the aim that research activities remain nationally and internationally connected, and capable of delivering impact well beyond fusion alone;
- Consider how best to focus ongoing and future research activities to achieve maximum benefit both for fusion, for the wider research community, for industry and for UK national priorities;
- Deepen its relationships with UK universities in line with the framework set out in this strategy;
- Place increasing emphasis on talent-led research.

### 4.2.3 Commercialisation

The UK Fusion Strategy affirms a core responsibility of UKAEA Group: to develop a vibrant UK fusion industry and supply chain, in line with its mission to use fusion to deliver economic benefits for the UK. While this responsibility is held collectively across the Group, this section focuses on the approach of UKAEA's National Fusion Laboratory (hereafter UKAEA). This emphasises identifying, developing (with appropriate protections) and ultimately commercially exploiting knowledge assets, ranging from scientific data and software to expertise and intellectual property (IP). UKAEA is generating and progressing a pipeline of opportunities that are expected to become potential spin outs, IP licences, and joint ventures with industry partners. It is intended that in many cases these new commercial entities will go on to act as suppliers to UKFE and other fusion developers as part of the UK fusion supply chain, as noted in the UKFE Strategy.

In progressing these opportunities, UKAEA will consider what represents the most appropriate commercial mechanism to secure and grow long-term economic value for the UK, seeking to collaborate rather than compete with existing UK industry. Routes will be chosen based on market demand, technology maturity and economic impact, and will prioritise factors such as UK industrial growth and sovereign capability. Procurement and collaboration agreements will underpin engagement with external experts, research establishments, and industry partners.

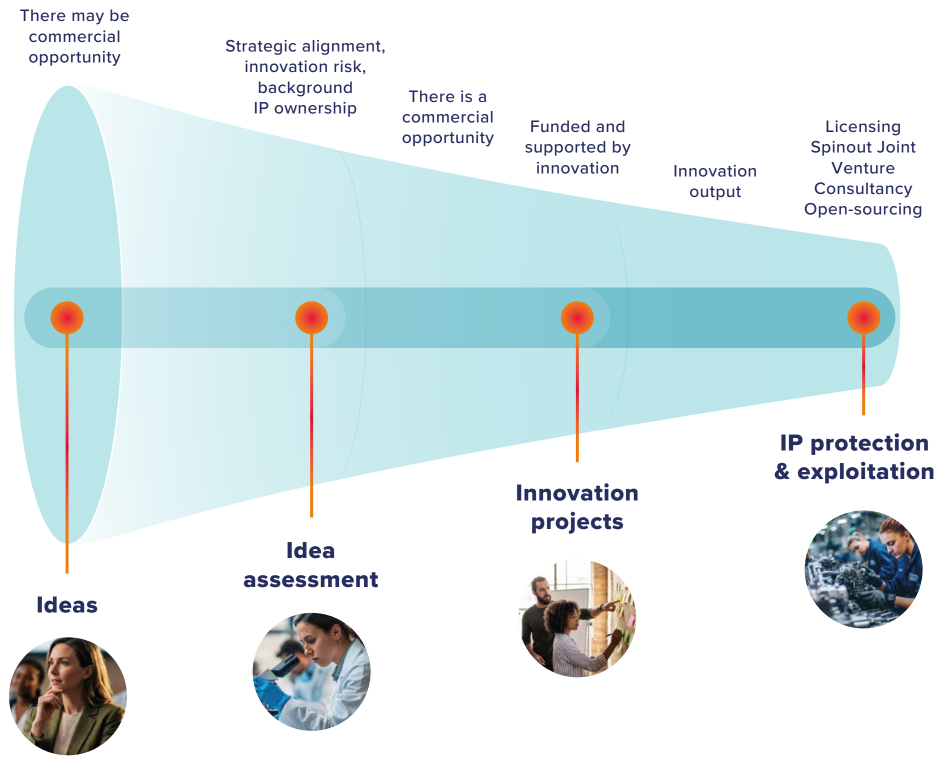



**Figure 7 - Illustration of the UKAEA Innovation Funnel.**

A further element of the strategy is to maximise technology transfer opportunities to exploit innovation for wider economic, societal, and scientific benefit. A dedicated Technology Transfer Hub serves as the proactive capability for market validation, development, and exploitation of knowledge assets. The strategy also includes building an external innovation ecosystem through partnerships, secondments, and global networking. This capability is increasingly embedded within UKAEA, which will continue to role-model this approach for the wider UK public sector and work with others to share best practice in commercialisation and technology transfer.

THE FUSION CLUSTER

The Fusion Cluster is a UK initiative to build connections across the fusion sector and beyond to identify shared opportunities. UKAEA is working with the Fusion Cluster and its members to maximise potential for technology transfer and collaboration.

This strategy confirms that UKAEA will:

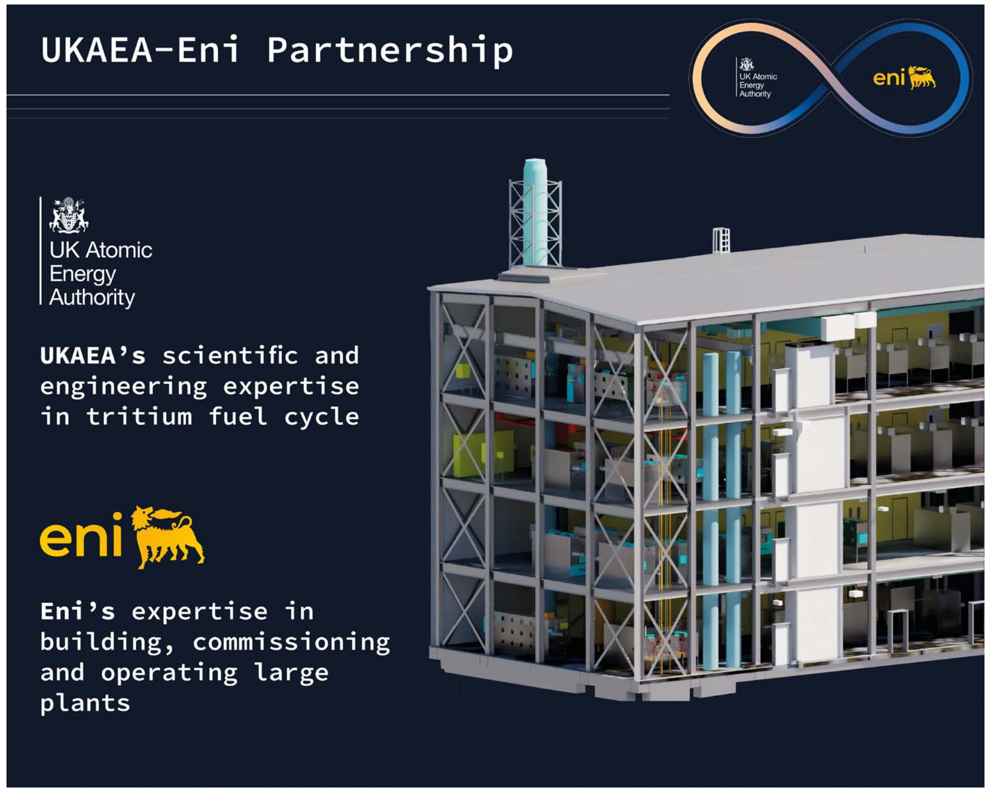
- Continue to progress Innovation and Technology Transfer opportunities as part of the Fusion Futures programme;
- Appraise the commercialisation potential of activities across UKAEA – particular areas of potential are summarised at a high level to illustrate UKAEA's strategic approach in the column "Secure UKAEA-originated capabilities for future commercial exploitation" on page 36-37. This does not necessarily preclude collaboration with external partners in these areas.

## 4.2.4 Industry

This section considers how UKAEA can both work with the supply chain to build fusion capabilities and to attract existing industrial capabilities into fusion, to help grow a fusion industry. This aligns strongly to UKRI's renewed focus on supporting innovative companies. In understanding how to prioritise relevant activities, UKAEA seeks to understand where the highest impact capability gaps and investment priorities are, considering over the coming years both what UKAEA can offer and what the fusion and adjacent sectors in the UK and overseas will need. The Fusion Industry Association routinely publishes a Supply Chain Report[16] which is invaluable for understanding the opportunities across the global fusion sector.

Looking at the fusion sector specifically, demand in the short to medium-term is expected to be driven by early pilot plants and public experimental facilities, with an emphasis on modelling and design services to validate concepts prior to large-scale hardware procurement. Initial hardware orders for pilot plants are expected to occur during this phase, but the staged development logic of fusion means that hardware demand – particularly for complex subsystems such as fuel cycle components, breeder blankets, and remote handling – may be based on simulation outputs. As and when these models are sufficiently developed, further pilot plant procurement activities would be expected, and in due course the emergence of repeatable industrial-scale fusion systems[17].

In this context, UKAEA will work to create opportunities for UK companies to build skills, technologies and capabilities via a wide range of mechanisms, including strategic contracts, commercial partnerships, joint venture and investible vehicles for IP-driven opportunities. The aim is to maximise the benefits of these activities to adjacent industrial sectors wherever possible. As with UKAEA-derived commercialised assets or entities described in the previous section, such industry-based mechanisms will be important partnering or supplier opportunities for UKFE, and key to unlocking investment into the fusion sector.




UKAEA has consistently created such opportunities across the sector to enable the UK supply chain to grow and develop. The [Fusion Futures Industry Capability] programme has engaged with almost 150 companies over the past two years, with over 30 being new entrants to fusion. The [Fusion Industry Programme] has supported early-stage commercialisation projects, covering costs for access to facilities or for performing feasibility studies, while maintaining clear and fair IP arrangements. Alongside this strategy UKAEA has published a [Fusion Supply Chain guide for Small and Medium sized Enterprises (SMEs) in the UK].

[16] FIA-Supply-Chain-2025-Report.pdf
[17] This assessment has been informed by Fusion Primes Demand Mapping, July 2025, UKAEA / Helixos.



This strategy confirms that UKAEA will:

- Deliver projects and programmes across its portfolio in a way that explicitly seeks to grow UK-based industrial capability, and set out in the column "Grow UK-based industrial capability" on page 36-37;
- Continue to work closely with the Fusion Industry Association and other partners across the fusion sector;
- Progress its market engagement strategy, particularly with SMEs;
- Work with the Government to develop new proposals to support supply chain capability and unlock new investment subject to affordability.

### Securing Value from UKAEA fusion in UK Industry

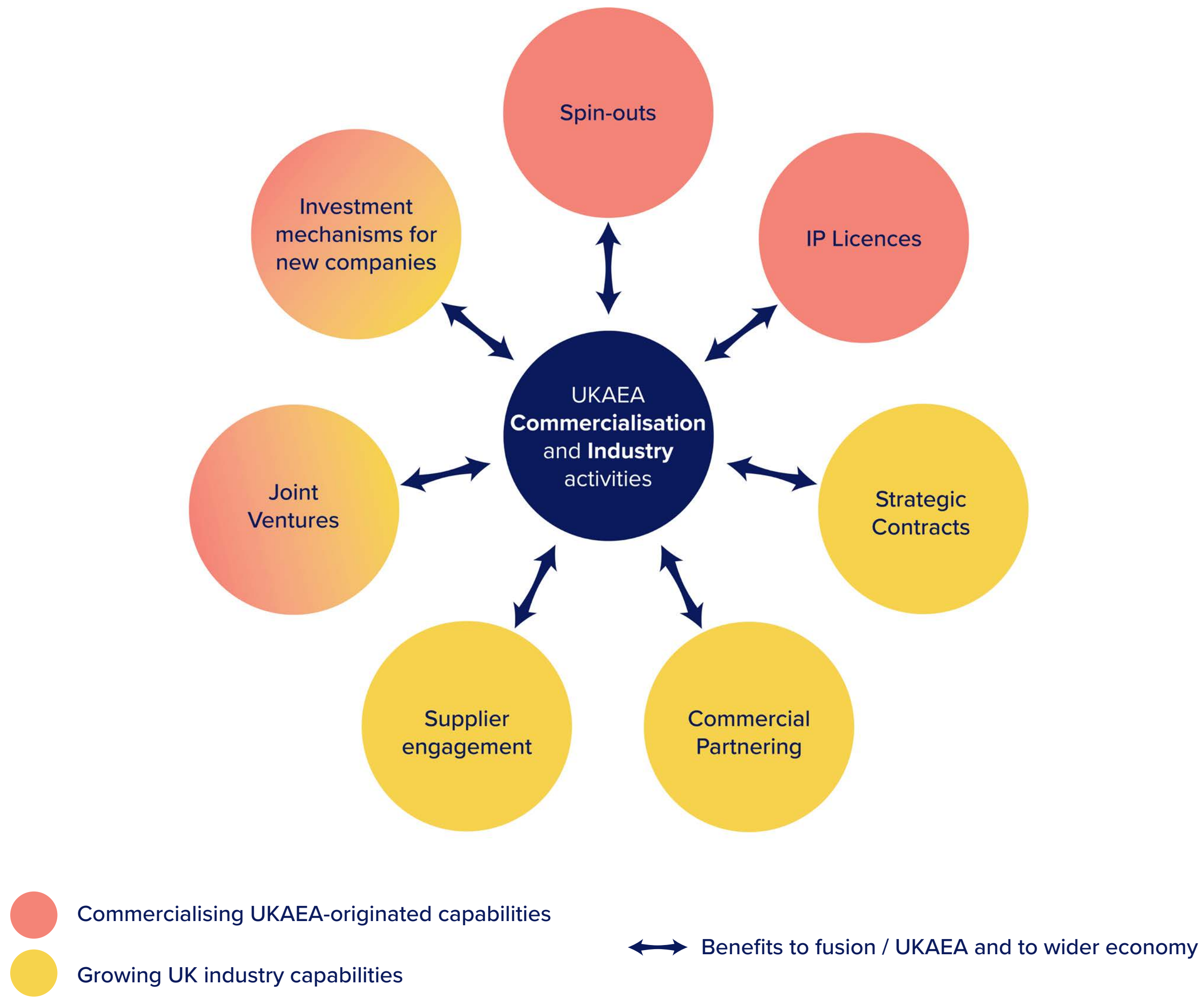



**Figure 8 - Illustration of UKAEA's twin approach to commercialising its knowledge assets and working with industry to strengthen fusion capability in the UK supply chain.**

# 4.3 Place

**UKAEA Group is working to transform its sites into dynamic centres of activity that accelerate fusion research, foster innovation clusters, and deliver lasting value to both local communities and the nation as a whole. This effort is being brought together into a unified UKAEA Group Estates Strategy.**

## Whitehaven: RAICo

With its primary site in Whitehaven in Cumbria, RAICo is a network of Robotics and Artificial Intelligence Collaboration (RAICo) hubs. The Whitehaven site contains facilities required to support the development of robotics and artificial intelligence solutions for nuclear decommissioning and fusion engineering challenges.

**This strategy confirms that UKAEA Group will accelerate opportunities to increase efficiency and capability-pooling via the coordinated development and deployment of Robotics and Artificial Intelligence solutions across UK nuclear, as part of its efforts to commercialise UKAEA-developed robotics capabilities. This relates to a UKAEA Flagship deliverable (see page 31).**


## Rotherham: UKAEA South Yorkshire

**This strategy confirms the naming of the UKAEA Group facility at Rotherham as "UKAEA South Yorkshire".**

"UKAEA South Yorkshire" will act as a strategic centre for fusion technology, focusing on industrial collaboration, skills development and local partnerships. It will bridge with STEP Fusion at West Burton nearby, forging a 'fusion corridor' that connects regional expertise and supply chains directly to STEP.


## Culham: the home of UKAEA

UKAEA's major fusion research facilities, including MAST-U, MRF, RACE and in the coming years H3AT and LIBRTI, are all based at Culham. Maintaining these facilities and the broader specialist infrastructure necessary to address fusion's challenges as described in section 4.1 is central to the operation of the Culham Campus. Alongside this, UKAEA is working to modernise and proactively manage inherited assets and repurpose existing infrastructure and facilities for the needs of tomorrow. The Strategic Investment & Development for Energy & AI (STRIDE) programme will use the designation of Culham Campus as the UK's first AI Growth Zone to bring in private sector expertise and funding to support the development of an increasingly commercially led technology campus. The integrated UKAEA Estate Strategy brings together asset management, accommodation, facilities, and commercial planning into a single framework. The JET Decommissioning and Repurposing Programme also plays a central role in this transformation. The second tranche of this programme is planned to run from 2026-2030 and will focus on repurposing land and buildings that once accommodated the JET power supplies.

## West Burton: the home of STEP

The West Burton site was chosen as the home for STEP Fusion, the UK's prototype fusion power plant, following a two-year competitive process involving technical and socio-economic assessments. West Burton is an iconic site within the East Midlands' "Megawatt Valley". Its position on the River Trent puts it at the heart of the emerging Trent Supercluster, with STEP Fusion acting as the anchor programme powering a new clean energy corridor across the region. UKAEA Group is considering how to use the opportunity to develop West Burton with commercial and other local partners to become the centre of a significant innovation cluster that attracts high-tech industries and investment.

## 4.4 People

UKAEA Group is currently the world's largest fusion organisation, with a workforce of around 2,500 talented individuals. UKAEA Group is dedicated to building and nurturing this talented workforce to tackle the evolving challenges of fusion science and engineering. The remainder of this section refers to UKAEA's National Fusion Laboratory, hereafter "UKAEA".

### 4.4.1 Empowering People, Advancing Mission

UKAEA celebrates its multi-national workforce, with employees from around 70 different nationalities contributing diverse perspectives invaluable for solving complex problems. UKAEA recognises that an attractive, competitive pay and reward framework is vital for recruiting and retaining the talent necessary to advance its mission and strategy. UKAEA has implemented a revised pay and reward system, benchmarking pay scales against market standards. UKAEA's commitment is to maintain a total rewards and benefits package that remains compelling, current, and flexible – within public sector guidelines – through ongoing collaboration with employees and trade union partners.

UKAEA's workforce planning enables it to identify current and future staffing and skills requirements, ensuring it attracts, retains, and develops the talent needed to achieve its mission and objectives. This is central to maintaining agility and pace, technical leadership, line management and other skills critical for an effective and efficient organisation.

Informed by its Equality, Diversity, Inclusion & Wellbeing Strategies, UKAEA will continue to foster a workforce and culture focused on delivering its mission and goals, while setting the standard for an inclusive and people-centered organisation in the UK's research landscape.



### 4.4.2 Fusion Opportunities in Skills, Training, Education & Research (FOSTER)

Fusion Opportunities in Skills, Training, Education & Research (FOSTER) is UKAEA's flagship programme dedicated to developing the future fusion workforce. Its ambitious vision is to provide thousands of new training and learning opportunities for the UK fusion skills pipeline. This will be achieved by collaborating with industry, academia, and international partners to increase apprenticeships, graduate and postgraduate positions (including Masters, PhDs, and post-doctoral roles), expanding access across the sector. Recognising fusion's workforce challenge as intertwined with the broader clean energy and engineering fields, FOSTER leverages "the power of adjacencies" by deepening partnerships with companies and agencies throughout clean energy, aligning training and qualifications to complement wider workforce initiatives. By contextualising fusion within the broader clean energy ecosystem, FOSTER aims to make the fusion sector more appealing and sustainable for workers, while enhancing the UK's overall clean energy skills base.

# 4.5 Delivery 2026-2030

Of the Government's confirmation of £2.5bn towards fusion between 2025/26-2029/30, almost £2.48bn will be allocated to UKAEA Group, with much of this flowing to industry and the wider fusion sector[18]. A high-level breakdown is below.

**Between 2025/26 and 2029/30 UKAEA Group will be allocated:**

- £1.3 billion for UK Fusion Energy, for the next phase of delivering STEP in partnership with industry, of which £700m will be invested in private industry including construction, engineering and other contracts;
- £920 million for UKAEA's National Fusion Laboratory's cutting-edge R&D infrastructure and facilities including:
  - operating its fusion R&D facilities and infrastructure such as MAST-U
  - completing new facilities such as H3AT
  - developing and building the LIBRTI facility
  - decommissioning and repurposing of JET
  - ongoing development of Culham site infrastructure
- £190 million for UKAEA's National Fusion Laboratory's projects and programmes focused on internationally collaborative research, innovation and commercialisation, and wider industry support and sector investment;
- £125 million into developing the AI Growth Zone (AIGZ) at Culham, including £45 million on the new 'Sunrise' fusion-dedicated supercomputer and £80m for ongoing research computing activity and preparations to exploit a future large-scale AI supercomputer for fusion as part of the Culham AIGZ;
- £50 million on developing fusion skills, training over 2,000 people in fusion related disciplines, via the FOSTER programme and research secondments.

In relation to UKAEA's National Fusion Laboratory (hereafter UKAEA), these spending plans have been reviewed against this strategy[19] to confirm strategic alignment. The framework of this strategy has been used to identify:

- A set of thematic objectives between 2026 and 2030;
- High-level "technical outcomes by 2030".

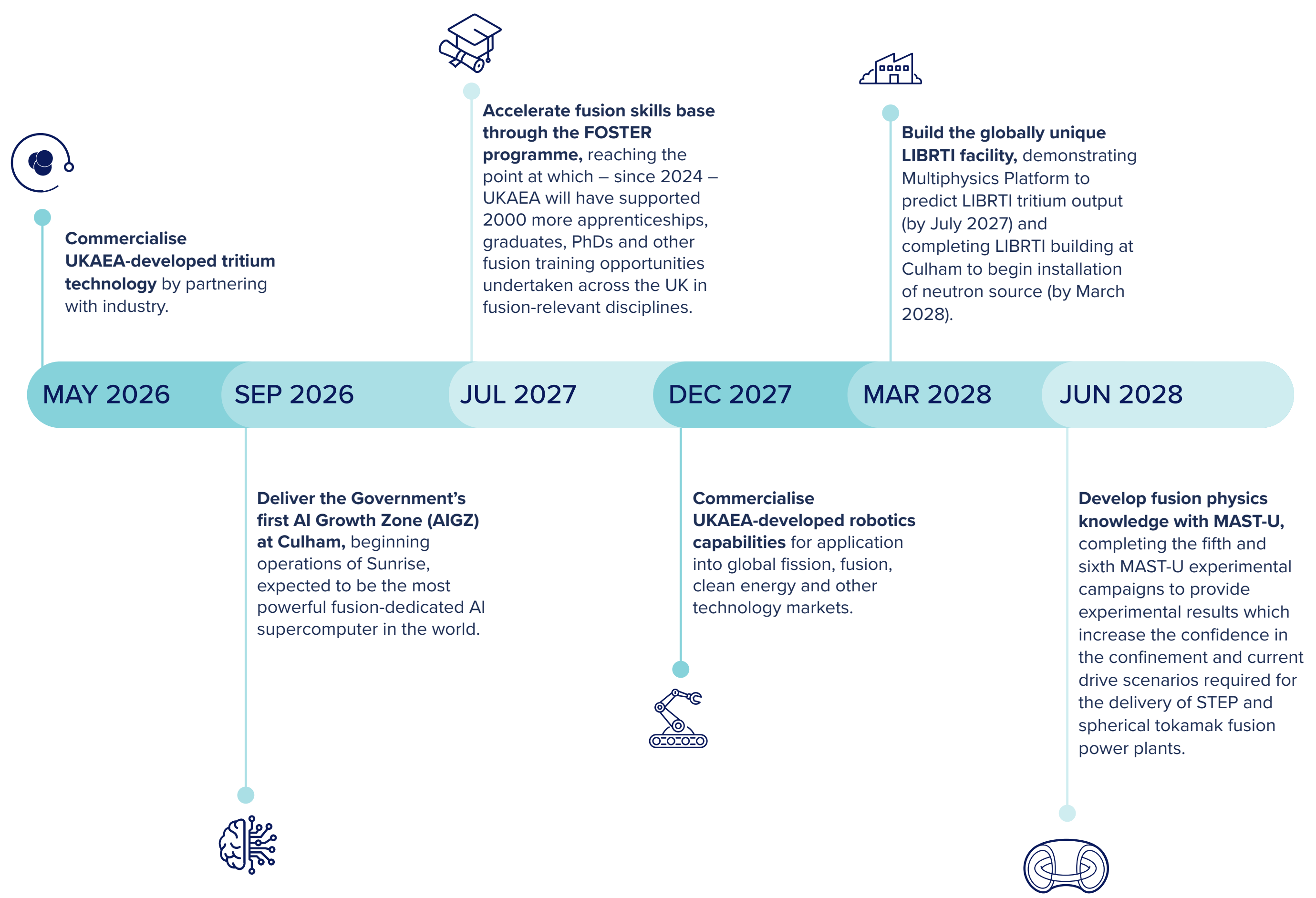
The colours used in these exercises relate directly to figure 6 on page 19, to figure 10 on page 39 and the Logic Model on page 40-41, to illustrate how UKAEA's portfolio of activities work towards scientific and economic benefits while fulfilling UKAEA goals – though in reality activities involve multiple themes and benefits.

Delivering this portfolio requires the efficient and effective performance[20] of UKAEA Group. Critical to this are UKAEA Group's central and enabling functions[21]. UKAEA Group is working to build capacity in key areas, particularly as its commercial activities with industry become more dynamic and complex.

## 4.5.1 Flagship Targets

The Government has identified from the UKAEA Group portfolio a set of "flagship targets" that are representative of the breath of ambition put forward in the UK Fusion Strategy. While only a small sub-set of activities from across UKAEA's portfolio, the flagship targets serve to demonstrate the range of tangible near-term scientific and economic benefits associated with fusion. Those related to the UKAEA's National Fusion Laboratory are illustrated in figure 9. These are reflected on the subsequent Thematic Objectives and Outcomes 2030 exercises via symbols in those tables.

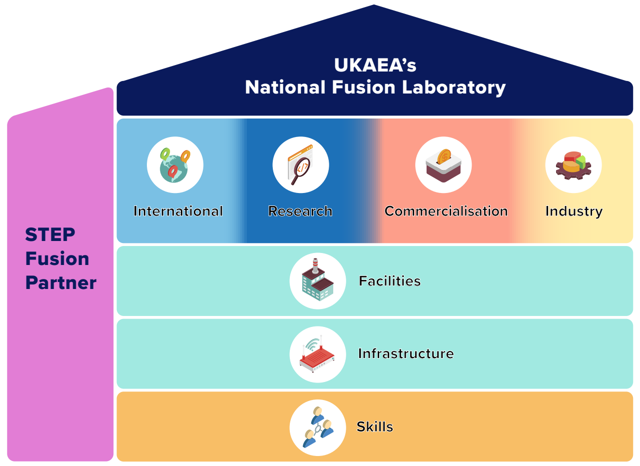
**Figure 9 - Illustration of "Flagship Targets" set out in the UK Fusion Strategy owned by UKAEA's National Fusion Laboratory.**




[18] It is assumed that the Government will not materially change this funding settlement prior to 2030/31.
[19] The scope of this review was all activity that is primarily RDI (or that of UKAEA's capabilities and infrastructure that directly enable these RDI activities), and funded A) by DESNZ Grant-in-Aid between 2025/26-2029/30 as part of the £2.5bn SR settlement or B) with other grant or commercial funding. This exercise also included a review of the latest assessments of project delivery and value for money. The scope excluded people and skills initiatives, non-specialist building and infrastructure works and all corporate and operational activity.
[20] UKAEA Group's Annual Report uses the theme "performance" to appraise UKAEA's central and corporate functions vital to the delivery of its mission.
[21] These functions includes: commercial, financial and legal functions; technical and buildings services across UKAEA sites; health, safety and assurance functions; and other technical and operational services essential for running the organisation. The size and scope of many of these functions is informed by the legal and regulatory obligations on UKAEA Group and the evolving requirements of UKAEA Group's complex portfolio.

## 4.5.2 Thematic Objectives 2026-2030

UKAEA's National Fusion Laboratory has developed a set of very high-level "Thematic Objectives" for each year between 2026 and 2030, shown in the table below. This brings together business and corporate planning exercises[22] undertaken within 2025/26 based on the framework set out in this strategy. Commercial elements and other specific details have been removed. Alongside this, an additional row of high-level STEP Fusion Partner delivery milestones is included, to better illustrate the full portfolio of the National Fusion Laboratory during these years. This exercise is not intended to be used for formal portfolio oversight but to use the framework of this strategy to illustrate how UKAEA intends to progress current activity towards sets of broader strategic outcomes by 2030, beneath which are many individual technical outcomes (see next section). Details will evolve over time as new opportunities are identified and progressed. Those items below which relate to "Flagships" (see section 4.5.1) are marked via the ⚑ symbol.




| | 2026 | 2027 | 2028 | 2029 | By 2030, UKAEA will have... |
|---|---|---|---|---|---|
| **STEP Fusion Partner** | • Establish sovereign fusion data and AI infrastructure to support STEP design validation.<br>• Demonstrate plausible solutions for potential showstoppers for STEP plasma scenario. | • Verify key engineering model predictions by comparison against multiple experiments.<br>• Support the development of the virtual STEP digital architecture. | ⚑ Validate STEP-relevant heating and current drive physics in MAST-U.<br>• Deploy a plasma control testbed to validate reactor control algorithms.<br>• In-silico qualification and neutron irradiation data available for critical STEP materials. | • Support the development of mature digital twins and multi-scale models to formally define STEP's design, safety and performance margins.<br>• Complete a neutronics-led novel solid breeder design to maximise plant-based breeding metric.<br>• Support the design and operation of Model Coil Test Facility (MCTF) and Advanced Research in GHz Operation (ARGO). | **...Supported the development of the detailed design of the STEP prototype power plant.** |
| **International** | • Renew and initiate formal collaborations with international labs and universities. | • Transform key partnerships into multi-year programmes of activity and agree new cooperation agreements with major institutions. | • Increase collaborative data sharing and joint projects, and use UKAEA's emerging Fusion Data Commons and new facilities to attract international users and undertake co-authored research. | ⚑ Showcase Sunrise and its successes achieved so far as the premier international hub for "AI for fusion science".<br>• Promote international cross-facility experimental campaigns. | **...Integrated UKAEA's facilities and expertise into global fusion programmes.** Long-term alliances are delivering shared benefits and reciprocal facility access. UKAEA is playing a leading role in major joint experiments and design efforts worldwide and helping to set global standards for fusion. |
| **Research** | ⚑ Use the 5th MAST-U experimental campaign to obtain world-first data on plasma exhaust, detachment, and ELM suppression relevant to STEP.<br>• Increase modelling & validation efforts to prepare for future exploitation of new facilities. | ⚑ Achieve further fusion science demonstrations (including establishing MAST-U as a platform for plasma control innovation). Establish reference digital twin and modelling frameworks to enhance knowledge capture and tool sharing across UKAEA programs. | • Leverage integrated modelling and experiments to deepen understanding of multi-physics problems. Increase the use of scenario analyses, improving confidence in design choices and risk assessments. | • Continue to expand validation experiments to address uncertainties in key fusion power plant physics and engineering areas. | **...Sustained UK leadership in fusion science & technology,** evidenced by experimental data and advanced simulation models, a record of high-profile publications and citations, and authoritative design tools and validation methodologies that progress towards the world's first fusion pilot plants. |

[22] The content of the Thematic Objectives Summary is informed by three core sources:
- UKAEA 2030 Technical Outcomes: See section 4.6.1.
- Corporate Performance Measures (CPMs): UKAEA annual CPMs establish targets for the upcoming financial year and serve as the formal mechanism for tracking performance. The Thematic Objectives Summary draws on some of those CPMs in 2026/27 which act as early "gates" or enablers on the pathway to the 2030 outcomes.
- Divisional Business Plans: These provide year-on-year delivery plans for each division, including key outputs and developments in relevant areas. The Thematic Objectives Summary reflects the most critical delivery objectives from these plans.

| | 2026 | 2027 | 2028 | 2029 | By 2030, UKAEA will have... |
|---|---|---|---|---|---|
| **Commercialisation** | • Accelerate commercial exploitation efforts to secure value and grow future revenue streams, and prepare spin-offs. Initiate new actions from the "innovation pipeline". | Grow the number of technical services contracts and licenses and broader cross-sector presence, particularly in commercialising UKAEA robotics expertise. | • Secure increased "return on investment" from UKAEA innovations by leveraging of IP and commercial partnerships. | • Mature revenue streams and spin-out pipeline, achieving an increased cadence of spin-outs, licenses, and service contracts. | **...Embedded commercial exploitation routinely across UKAEA.** The organisation routinely spins out companies and licenses technology in fusion and adjacent sectors. |
| **Industry** | Finalise new agreements with industry partners, particularly in tritium fuel cycle. Renew outreach efforts to engage new potential UK fusion suppliers. | • Increase UK supply chain involvement into UKAEA fusion projects. | • Host multiple external test campaigns in UKAEA facilities (e.g. ELSA magnet test facility and high heat-flux rigs) for industry partners. Advance UK capabilities in specialty materials, to enhance UK's sovereign supply in critical areas. | • Support increased numbers of UK companies to deliver components, software, and services for fusion projects. | **...Increased the numbers of UK companies delivering products and services to UK and international fusion programmes** as a result of UKAEA collaborations and initiatives. Strategic joint ventures have matured into independent enterprises with permanent staff and commercial contracts. |
| **Facilities** | • Complete design of the LIBRTI building and achieve first concrete pour via Civils Award partner.<br><br>Begin operations of Sunrise, expected to be the world's most powerful fusion-specific AI supercomputer. | Demonstrate Multiphysics Platform to predict LIBRTI tritium output.<br><br>• Assemble H3AT's key systems and receive delivery of Uranium beds. | Complete LIBRTI building at Culham to begin installation of the neutron source.<br><br>• H3AT Tritium Loop: begin inactive commissioning and receive delivery of gloveboxes. | • Integrate multi-physics liquid-metal/breeder test rigs into LIBRTI facility and begin producing data.<br><br>• Begin exploitation phase of the H3AT plant. | **...Completed new facilities H3AT and LIBRTI which are positioned as international user facilities.** LIBRTI is in full operation and is supporting STEP and private fusion firms, the H3AT inactive tritium loop integrated operations begins testing and active commissioning of the whole H3AT plant is underway. |
| **Infrastructure** | • Begin the next phase of decommissioning activity through JDR, including commencement of cabling works and early activity covering waste processing, storage design and preparatory engineering.<br><br>• Procure new high-capacity cabling for modernisation and upgrade of site power network at Culham via the STRIDE programme. | • Progress JDR including disposal of five tonnes of legacy solid waste and handover of several deplanted JET worksites.<br><br>• Complete installation and energization of new high-voltage substation and power cabling at Culham. | • Progress JDR including manufacture of intermediate-level waste buffer storage, completion of remote handling system design and commissioning, and handover of additional deplanted JET worksites.<br><br>• Implement new site-wide electrical supply control and data systems, so new grid infrastructure at Culham is fully operational. | • Progress JDR including bringing new infrastructure into operation, readying the remote handling system for in-vessel operations and starting in-vessel decommissioning phase 1. | **...Demonstrated sustained progress of JET decommissioning** through completion of in-vessel decommissioning phase 1 for tiles, packaging and characterisation of 50% of legacy JET waste, and completion of major tritium analysis laboratory scanning and sample analysis milestones.<br><br>**...Commissioned the high voltage power supply** to deliver reliable power for all facilities. |
| **Skills** | • Additional PhD/EngD candidates recruited into critical R&D areas Roll-out of the CROSS robotics apprenticeship program to upskill technicians in remote handling and robotics for nuclear facilities. | Increase the number of people undertaking technical training and apprenticeship in fusion relevant disciplines.<br><br>• Establish new fusion career pathways. | • Expand UKAEA's assorted training initiatives through collaboration with academic, technical institutions and skills stakeholders.<br><br>• Assess progress of targeted programmes to improve wider participation and skill uptake. | • Continue training and mentorship programmes at scale.<br><br>• Capture knowledge transfer from retiring experts. | **...Produced through the FOSTER and apprenticeship programmes a new generation of fusion scientists, engineers, and technical experts,** in support of STEP, workforce capability and the development of the wider fusion sector. |


RETURN TO CONTENTS
RETURN TO CONTENTS

## 4.5.3 Technical Outcomes 2030

The table below summarises individual technical outcomes UKAEA will deliver by 2030, framed by the area of technical focus (see section 4.1.3) and by the strategic themes and associated benefits (see section 4.2). It provides a level of detail below the content in the 2030 column of the Thematic Objectives table in 4.5.2. Those items which relate to "Flagships" (see section 4.5.1) are marked via the ⚑ symbol.

[23] As described in section 4.1, development and operation of cross-cutting enabling capabilities and infrastructure are critical to deliver these outcomes and strategically essential for UKAEA to maintain, even though these are not foregrounded through the presentation of these activities. One such cross-cutting activity is the operation and exploitation of the Sunrise facility – which is in and of itself a flagship target that relates to many of the outcomes feature above (particularly in the research column). Similarly, the depth of the integration challenge in fusion means that UKAEA is working to maintain levels of capability appropriate to its enduring RDI role alongside that of UKFE as the national fusion systems integrator. Ongoing efforts in this space are not foregrounded explicitly in the table, though are embedded within many of the other identified activities.

[24] It is recognised that new opportunities may emerge during this period and so some change to this portfolio is likely. The work of UKAEA as the STEP Fusion Partner for UKFE continues at pace, and this – as an overall organisational priority for UKAEA Group – will also cause the portfolio to evolve and change.

[25] "Fuel cycle" here focuses on the ex-vessel systems and the tritium plant for handling plasma gases primarily, not the breeding process and in-vessel materials behaviour (under materials and technology). Specific breeder and coolant choices can be concept-specific and changeable so are not included explicitly in these headline goals.

| UKAEA groups and facilities | | High-level summary of technical outcomes by 2030 that…[23, 24] | | | |
|---|---|---|---|---|---|
| **Technical Groups**<br>Main Programmes | **Anchor facilities** | **Access collaborative international capabilities and opportunities** | **Advance science and secure UK knowledge leadership through research** | **Secure UKAEA-originated capabilities for future commercial exploitation** | **Grow UK-based industry capabilities** |
| **Plasma**<br>UKRI research, STEP (fusion partner) | MAST-U | • Reinforced strategic plasma collaborations with the US and European partners | • Generated understanding in plasma design and performance<br>• Enhanced plasma simulation codes | ⚑ Exploitation of MAST-U to develop control and operational solutions<br>• Harnessed datasets for AI-driven modelling and system development | • Engaged UK supply chain in advanced fusion diagnostics |
| **Fuel cycle**[25]<br>UKRI research and grants (eg. ASTRIA project), STEP (fusion partner), JDR & Waste Innovation | H3AT Tritium Loop (under development), Active Tritium R&D Lab facility, Material Detritiation Facility | • Established the H3AT loop as an international user-access facility<br>• Implemented Canadian strategic collaborations<br>• Reaffirmed collaboration with European partners in tritium | ⚑ Generated datasets to underpin digital modelling and design | • Delivered experimental facilities and data to help develop tritium subsystems and components<br>• Improved process plant technologies to inform power plant scale systems | • Increased capability across Tier 2 and 3 suppliers in tritium technologies<br>⚑ Partnered with industry to realise new tritium-related opportunities |
| **Materials**<br>UKRI research and other research grants, LIBRTI fusion fuel capability programme, STEP (fusion partner) | Materials Research Facility, LIBRTI (under development) | • Collaborated in materials research using facilities in and links with USA, Japan, Belgium and Germany<br>⚑ Established via LIBRTI programme a UK breeder blanket engineering test capability, with an in silico capability to iterate breeding prediction, for international collaboration | ⚑ Developed machine learning strategies, data and models for understanding fusion materials and environments | • Established LIBRTI multi-physics platform know-how<br>• Developed a range of nuclear (fission and fusion) relevant composites, coatings and shielding | • Developed new industrial capabilities in fusion steels, tungsten and composites |
| **Robotics**<br>JDR & Waste Innovation, STEP (fusion partner), ESS Active Cells Facility, LongOps (with TEPCO Japan), UKRI research and other research grants | RACE (Culham), RAICo1 (Whitehaven) | • Handover of ESS active cell facility to ESS<br>• Completion of ITER hotcell service contract<br>• Operated Large Hadron Collider beamline inspection at CERN Supported early remediation activities at Fukushima Daiichi | • Developed adaptive control systems for dynamic loads in confined space, in-situ repair technology, and novel welding and cutting tooling and processes | • Demonstrated solutions in maintainable magnet technology and mechanical seals<br>• Completed JET in-vessel decommissioning with robotic techniques | ⚑ Realised commercial opportunities originating in UKAEA robotics<br>• Developed radiation hardened electronics |
| **Fusion Technology**<br>UKRI research and other research grants, STEP (fusion partner) | Fusion Technology Facility, including ELSA, HIVE and HHF Laser | • Secured qualification routes for fusion materials using global standards bodies<br>• Reinforced UK thought leadership in integrated design via work on international fusion programmes | • Generated datasets, models and skills in fusion technology verification and validation | • Expanded commercial service provision in understanding the qualification and development of specific fusion components and systems | • Completed delivery of a suite of facilities for the testing and qualification of components and systems |

## 4.6 Impact

The economic opportunities associated with fusion are increasingly clear with the UK well-positioned to capture a share of an estimated potential £3-12tn total global capital investment in fusion in the period 2050-2100[26]. Technologies from fusion R&D are benefitting industry in areas including robotics, materials, medicine, and artificial intelligence.

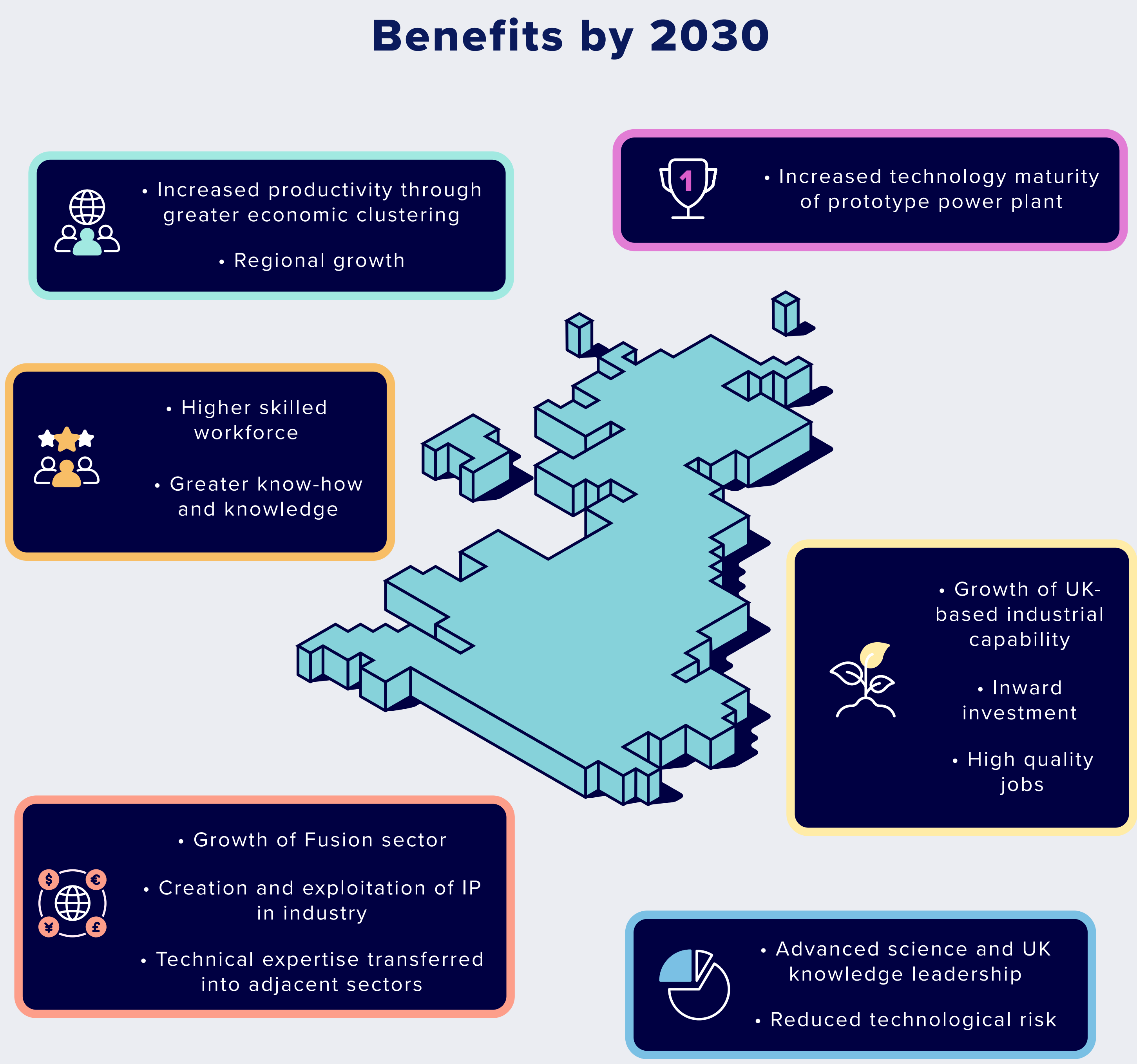
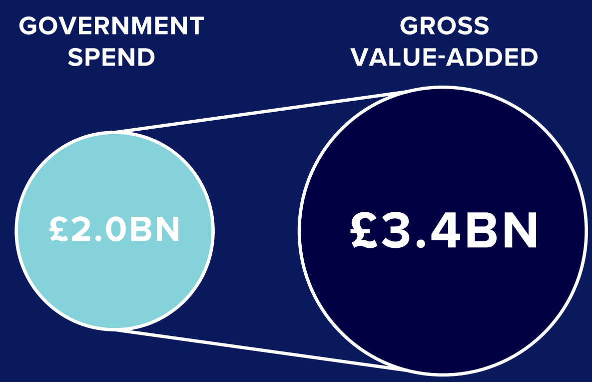



**Figure 10 - Benefits by 2030 arising from UKAEA Group portfolio**

### UKAEA Fusion R&D: Economic Impact and Funding (2009/10 - 2024/25)

UKAEA uses different approaches to evaluate realisation of these benefits. Quantitative analysis undertaken by UKAEA and DESNZ suggests that the gross value-added (GVA) impact of UKAEA fusion R&D activities between 2009/10 and 2024/25 was £3.4BN, with UK Government spend of £2.0BN over the same period.+




UKAEA Group programmes are already delivering significant benefits, for example:

- Between 2020/21 and 2024/25, an average of 6,000 jobs per year were supported in the UK economy by UKAEA Group activity, 60% of which were in the UK supply chain rather than within UKAEA Group.
- Within 2024/25 alone, UKAEA's FOSTER programme has supported 31 PhDs, secured partnerships with 2 leading UK universities to expand Masters-level training for fusion in the UK, and engaged nearly 50,000 school students through outreach activities.

As a publicly funded organisation, UKAEA Group has a responsibility to maximise the value for money of its activities. UKAEA Group has established frameworks, processes and resources to evidence impacts. A new organisation-wide Impact Reporting Framework is working to capture, analyse and report impacts across all programmes, creating consistent, portfolio-wide alignment around outcomes and benefits. This relies on close collaboration between UKAEA and external partners, including academia and industry to capture and understand the full breadth of impacts arising from UKAEA Group interventions.

The logic model below illustrates how programmes and initiatives are aligned to the delivery of strategic benefits for the UK, which also help achieve UKAEA's goals. The organisation-level portfolio logic model links to each programme's model, creating a "golden thread" from programme outputs to strategic impacts. The colour coding relates to Figure 6 on page 19, and aligns with Figure 10, left, and the Thematic Objectives and Technical Outcomes tables in section 4.5, noting that in reality activities involve multiple themes and benefits.

[26] Internal Department for Energy Security and Net Zero-UKAEA-UKFE analysis of total capital investment (2023 prices) in Fusion Power Plants between 2050-2100 based on currently unpublished UCL Energy Institute global TIMES modelling. Total estimated fusion energy installed capacity multiplied by capital cost estimates. These estimates could be considered conservative, as they only capture capital costs and do not account for higher estimates of energy gain in fusion plants and co-production opportunities such as heating and desalination. Given the nascency of the technology, assumptions are highly uncertain.

+ GVA and UK government funding in 2024/25 prices, direct and indirect effects only. The amount of GVA for every £1 in UK government funding has reduced compared to the London Economics analysis undertaken in 2020 because between 2009/10 and 2023/24 the amount of UK government funding has increased in relation to external funding, primarily that received from the European Commission to operate the Joint European Torus (which ceased operations in 2023).

## Portfolio Logic Model

### INPUTS
Resources needed

- UK Government funding
- Private investment, resources and capability
- Existing knowledge, skills and expertise in fusion
- Academia resources and capability
- Existing facilities and research infrastructures
- International capability
- Outreach and Comms

### ACTIVITIES
Carried out by the programme

- UKFE-led STEP (integrated design and technology development)
- Research across key technical challenges
- UKAEA Fusion Partner work packages for STEP
- Research Grants (EPSRC)
- Fusion Futures (internationally collaborative research)
- Fusion Futures (Innovation and Business Development)
- RAICo
- UKFE commercialisation as national fusion systems integrator
- UKFE-overseen STEP work packages led by industry partners and supply chain
- Fusion Futures (Industry Capability)
- Operation of UKAEA facilities (MAST-U, MRF, RACE, FTF)
- Completion of new facilities (LIBRTI, H3AT)
- Repurposing and modernising site infrastructure at West Burton for STEP and at Culham via JDR and STRIDE programmes
- Developing computing facilities and infrastructure (Sunrise, AIGZ)
- FOSTER
- Secondments and Placements

### OUTPUTS
Delivered/ intended

- First of a kind fusion power plant systems and technologies, designed, built and commissioned
- Technical outcomes achieved*
- Research publications
- International partnerships
- Creation of patents, licenses, prototypes, joint ventures and spin-out companies
- Investment into supply chain
- Increase in supplier pool & first-time bidders
- Mature existing supplier capability
- New research facilities in operation
- Strategic partner established for Culham development, growth of on campus companies
- West Burton site readied
- Land and facilities repurposed
- Increase in PhDs, apprenticeships and other training opportunities

### BENEFITS

- Increased technology maturity of prototype power plant design, industrial-scale fusion systems and components
- Advanced science and UK knowledge leadership
- Reduced technological risk
- Growth of Fusion sector
- Creation and exploitation of IP in industry
- Technical expertise transferred into adjacent sectors
- Growth of UK-based industrial capability
- Inward investment
- High quality jobs
- Increased productivity through greater economic clustering
- Regional growth
- Higher skilled workforce
- Greater know-how and knowledge

### GOALS

- **Power Plant** Design, deliver and operate fusion power plant
- **Problems** Solve challenges of sustainable fusion energy - from design through to decommissioning - with world-leading science and engineering
- **Product** Develop technologies for fusion power plant and adjacent sectors
- **Prosperity** Enable a thriving UK fusion industry that exports fusion technology around the world
- **Place** Grow clusters that accelerate innovation in fusion and related technologies
- **People** Nurture the talented, diverse people needed to deliver fusion energy

*Illustrated in the international and research columns on pages 36-37

## 4.7 Progress and Potential

While fusion facilities have been in operation around the world for many decades, no facility has yet demonstrated net energy gain from fusion. There remain considerable technical challenges in the development of the complex components and systems required and the integration of these into a deployable power plant that can be operated at commercially relevant levels of productivity and availability. It is the mission of UK Fusion Energy Ltd to address this challenge as a national fusion systems integrator.

In that context, and against a backdrop of increasing investment and expectation, UKAEA's National Fusion Laboratory (hereafter UKAEA) will renew its efforts to demonstrate how ongoing RDI activities progress the sector towards deployable fusion energy. This includes:

- Differentiating between progress towards research, prototypic or commercially relevant "end-states";
- Understanding the factors that inform or determine the future attractiveness of fusion (particularly in relation to other energy solutions), and how these factors could be reflected in today's R&D programmes.

### 4.7.1 Understanding progress towards fusion

To understand and enhance progress toward deployed fusion, UKAEA is beginning to develop a framework around technical end-states and progress metrics across its portfolio. This aims to reflect the diverse approaches – empirical, theoretical, and computational – that are needed to tackle the challenges of fusion. This framework will increasingly provide a fusion-specific way to support organisational alignment, prioritisation, and effective resource allocation. In considering how to develop and apply a framework of end-states and progress metrics, it will be important to reflect how fusion initiatives vary. These can be loosely categorised into four "types":

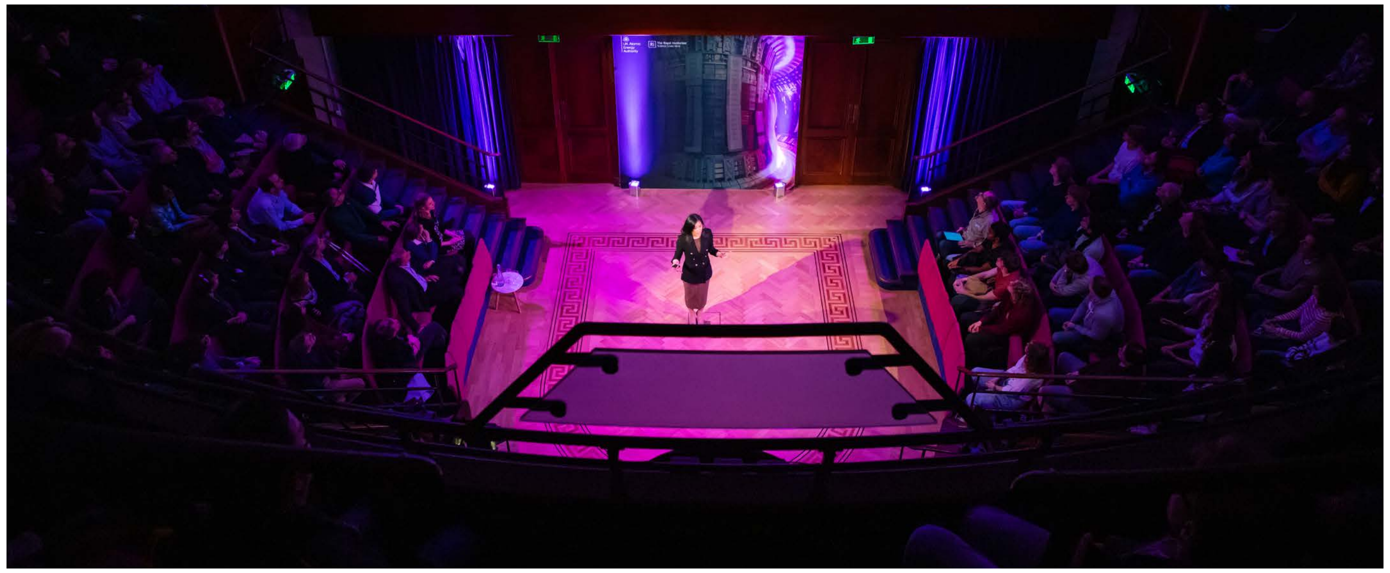
1. Exploration and Innovation – Discovery-driven research ultimately aiming to enhance affordability, attractiveness, and/or feasibility of fusion.
2. Enabling Platforms – Foundational capabilities supporting multiple fusion concepts without a single guiding design.
3. Pilot Plant Design and Build – Fast-paced, schedule-driven projects making proactive trade-offs to achieve some level of near-term demonstration.
4. Commercial Deployment Design, Build and Maintenance – Longer-term programmes focused on cost, reliability, and scalability.

An approach to end-states and progress metrics would likely differ across these four types of fusion initiatives. To be meaningful, these must reflect the character of the programme in question. Existing frameworks such as Technology Readiness Levels (TRLs) provide a starting point, but alternative or hybrid approaches may be needed to address radical uncertainties and integrability challenges. UKAEA would welcome engagement from the fusion and wider research community in this endeavour.

### 4.7.2 Understanding the potential of fusion

Under all technical pathways and historic precedence for market penetration, it is unlikely that fusion will make any significant contribution to global energy supply before 2050. After fusion energy is deployed at scale, demand would be expected to vary by jurisdiction. That would likely be higher where there is emphasis on large-scale, low carbon energy production, along with high population density and low availability of renewable resources and/or land[27]. Furthermore, what makes an "attractive" energy generating facility – fusion or otherwise – may be different from currently planned and projected energy technologies in view of climate and geopolitical changes. The balance between the relative power of energy consumers and energy producers in defining the market may shift one way or the other during the era in which fusion is expected to be commercialised progressively.

UKAEA is investigating these topics as part of its work to understand the global "pull" for baseload energy technologies such as fusion at a time when fusion might be deployed sustainably at significant scale, and how this could shape or be shaped by both RDI choices made in the near-term and activities being pursued by existing fusion developers.



[27] The commercialisation of fusion for the energy market: a review of socio-economic studies - IOPscience

# 5 Your views

This strategy represents the most comprehensive statement yet on how UKAEA's National Fusion Laboratory plans to work with partners across the UK and internationally to accelerate progress toward fusion energy. We recognise that this requires a broad community of expertise and therefore welcomes views and responses from organisations active in or adjacent to the fusion sector. In particular we welcome views (from the UK and overseas) from:

- Fusion researchers and university teams
- Fusion companies and technology developers
- International laboratories and research institutes
- Current UKAEA suppliers – and those interested in working with UKAEA
- Companies in adjacent sectors exploring fusion-related opportunities
- Innovators, entrepreneurs and startups

Whether you wish to comment on opportunities for deeper collaboration, highlight emerging research and technology areas relevant to UKAEA's work, or even challenge assumptions set out in this document, UKAEA would value your insights. UKAEA is especially interested in perspectives that can help ensure this strategy enables a thriving UK fusion ecosystem, strengthens international partnerships, and supports industry growth from early innovation through to largescale deployment, in line with the UK Fusion Strategy.

Please write to: **communications@ukaea.uk**

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

**Find out more**
**www.gov.uk/ukaea**

**Follow @UKAEAofficial**

United Kingdom Atomic Energy Authority
Culham Campus
Abingdon
Oxfordshire
OX14 3DB

CPS25.1041-1c