# Fusion Industry Taskforce Policy Recommendations for Technology in Fusion

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# Policy objectives

**The objectives of this pillar are to identify areas of technology that are critical to the success of the fusion sector in the UK, and to provide recommendations to the Government that will help to ensure fusion contributes to emerging technology development as effectively as possible.**

**Specify technology options and pathways for the UK fusion strategy** – To prepare the fusion ecosystem and focus on relevant technologies, the UK government should specify the most critical enabling technologies that will realise the commercialisation of fusion energy. Specifically, are technologies other than Magnetically Confined Fusion (MCF) still of value to the UK government? The government should specify the required timeline of TRL development for critical technologies such as breeder blankets. For low-TRL technology development, the government should clearly define the roles of Academia, Industry, and Research Organisations in technology development.

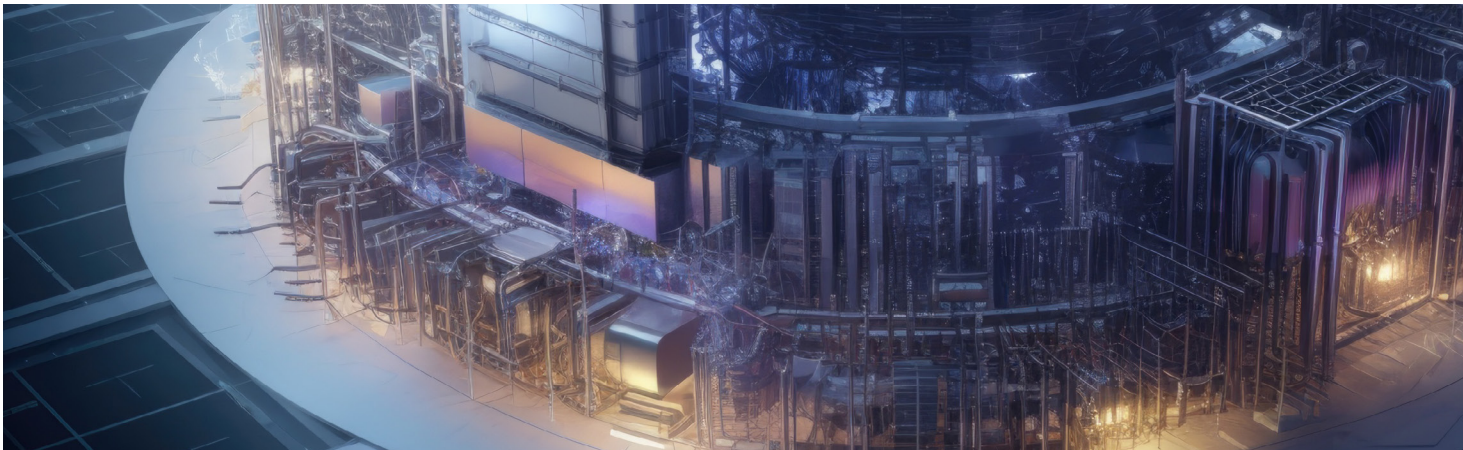
**Ensure modern digital technologies are embedded in all aspects of fusion** – As an emerging industry, fusion has incredible potential to adopt cutting-edge and developing digital technologies such as Artificial Intelligence and Machine Learning at-speed. Wherever appropriate, the UK should encourage the adoption of a digital thread throughout the evolution of fusion development, and encourage open, easy to access, interoperable data and software from public institutions.

**Capture and communicate the value of fusion technologies in the broader economy** – As the fusion sector matures, the unique technologies developed are increasingly seeing applications outside of fusion energy. These technological spin-outs, from magnet-based propulsion to neutron sources for medicine, must be appropriately captured and communicated. Even though electricity from fusion energy has not yet been put on to the grid, technologies developed by the fusion industry are generating value for the UK economy today.

**Identify and mitigate constraints for technology development** – For many technologies such as superconductors, breeder blankets, and plasma facing components, the access to the right materials and manufacturing skills and capabilities are vital. As early as possible, the UK should engage the materials, engineering and manufacturing sectors to identify possible resource constraints in developing or scaling new components or technologies, so that their development is not hindered or delayed.

**Create a future jobs map and invest in skills programmes** – As the fusion sector matures, the types of technologies and skills required to support the sector will change. The UK Government should create a 'jobs-map' of the expected skills needed in the emerging and mature fusion sector, and provide adequate support for skills development in emerging technologies.

**Leveraging established and advanced technologies from other sectors** – We urge the UK Government to support and encourage the adoption of cross-sector best-practice in the emerging fusion energy sector. Examples include modular construction (ship building), advanced joining and fabrication techniques (nuclear power), assembly flow practices (aerospace and automotive), all leveraging the best of modern practices in other industries. Foster collaborations with sectors such as nuclear fission, aerospace, automotive, electrification and storage and renewables.



FIT Recommendation #1

# Specify technology options and pathways in the UK fusion strategy

An appropriate balance between diversity and focus of technology development is necessary to deliver the UK fusion strategy. The UK government should specify this mix of enabling technologies in its fusion strategy, and regularly update this list of technologies and their development roadmaps. One key point to be answered and updated is whether the UK fusion ecosystem should be mostly working to develop technologies relevant to Spherical Tokamaks or wider fusion technologies.

The most important technologies for the UK strategy should leverage the skills and experience of the fusion institutions in the UK. For low and medium TRL technologies, the role of academia and industry should be clarified. The government should ensure the smooth transition from low to high TRL technologies by funding collaborations and partnerships to avoid the typical funding "valley of death" that is often seen in this TRL range.

FIT Recommendation #2

# Ensure modern digital technologies are embedded in all aspects of fusion

As a new and growing industry, fusion has the potential to adopt powerful new technologies free from the inertia of more mature industries. As such, the government should ensure that fusion becomes a leading industry adopting artificial intelligence and other digital technologies. These technologies can enable increases in organisational efficiency, massively speed up expensive simulations, and improve the management and analysis of experimental test facilities and plants.

To ensure the uptake of digital technologies, FIT recommends that digital technologies are not treated as siloed endeavours, but are instead specified as an integral, embedded part of projects, tenders and facilities. The government should also encourage a high standard of digital integration for projects in fusion, such as Building Information Modelling standards.

To enable digital innovation in the wider industry, the government should mandate institutions e.g. UKAEA to make data and software tools as open and easily accessible as possible.

FIT Recommendation #3

# Capture and communicate the value of fusion technologies in the broader economy

Enabling technologies not only accelerate the realisation of fusion energy - they are having a tangible impact on the UK economy today. From lasers to high temperature superconductors, to radiation hardened diagnostics and robust materials, many technologies born in fusion are being spun out to other industries. We recommend encouraging more reporting on the use of these spin-out technologies, and stronger communication of this value throughout the government and the general public. This will encourage the UK fusion industry to move away from the association of an isolated 'blue sky' research project, and towards a technology-rich industry already producing value.

FIT Recommendation #4

# Identify and mitigate constraints for technology development

There are many challenges facing the development of fusion technologies, some of which are too large for any industrial or academic body to face alone. For example, the development of first of a kind in-vessel components or breeder blankets for fusion depend upon the availability of resources such as Tungesten, Beryllium, or enriched Lithium. Similarly, the development of AI for fusion strongly depends upon the availability and quality of data from experiments and historic simulations.

FIT recommends that the government starts now to identify the materials, manufacturing, organisational or regulatory constraints that may slow the upscaling of technology development in the future. Once identified, the government should begin to construct policies to ensure these constraints are mitigated.

FIT Recommendation #5

# Create a future jobs map and invest in skills programmes

One of the most significant constraints in any new technology development is the availability of appropriate skills and workforce. If the government follows the first recommendation and clearly defines technology roadmaps for the UK fusion strategy, we recommend that this roadmap is used to create a future jobs map. In this way, the government may identify how the fusion workforce should evolve, and what the gaps are in skills and workforce makeup. If these skills gaps are identified, they can be filled through targeted upskilling or sideskilling programmes like those introduced by the FOSTER initiative.

FIT Recommendation #6

# Leveraging established and advanced technologies from other sectors

The fusion energy sector has numerous challenges and requires the development of novel technologies and materials to realise a viable fusion energy device. It is a sector which has many aspects (such as materials that can withstand high heat loads, robotics and lithium production) shared with established industries such as nuclear fission and aerospace. A fusion power-plant involves the construction of large buildings and infrastructure with conventional materials such as concrete and steel. In addition, an operational plant ultimately generates and sells energy. This aspect of fusion should not be disregarded, and we recommend leveraging technologies for electricity generation or the application of industrial heat, with attention to integrating with the evolving UK electricity grid and energy-consuming industries.

Because of these shared aspects of fusion development, we recommend that the UK government identifies and encourages the adoption of advanced technologies in mature industries throughout the fusion landscape. For example, nuclear fission and renewables deal with the recycling or disposal of hazardous waste and precious elements. Construction and logistics have been leveraging new software and data standards to increase the efficiency of complex projects.

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