

# Fusion Expert Group Opinion Paper

Towards the EU Fusion Strategy



**Independent Expert Report**

## Fusion Expert Group Opinion Paper: Towards the EU Fusion Strategy

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EUROPEAN COMMISSION

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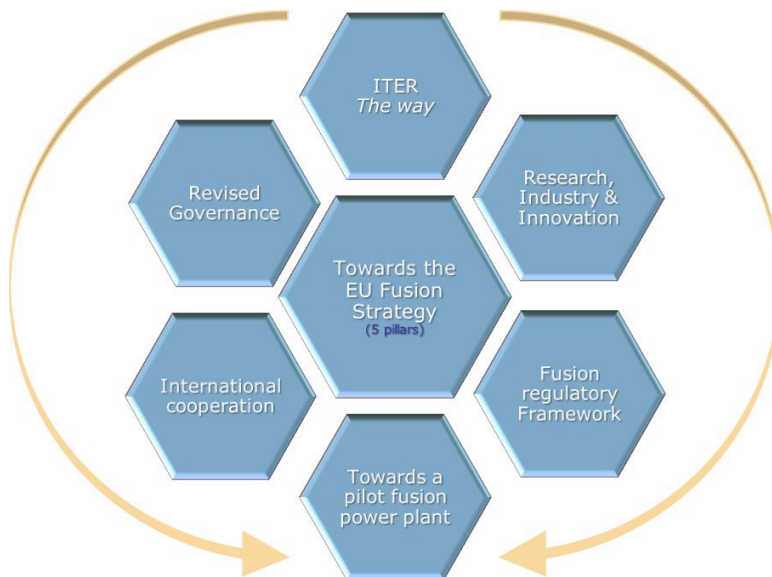
# 1. Introduction

The Fusion Expert Group's (FEG) primary mission is to support the development of an *EU Fusion Strategy*, intended to be published as a Commission Communication in view of the proposal for the Euratom Research & Training Programme<sup>1</sup> 2028–2032.

This FEG Opinion Paper envisions a future where fusion energy becomes a viable, sustainable power source for the EU. It provides key recommendations for shaping an *EU Fusion Strategy*, aiming to accelerate the transition from achieving fusion energy gain to the full commercialisation of fusion energy, positioning Europe as a global leader in the field. By leveraging existing research, contributions from Member States, outcomes from the ITER project gained during its construction and exploitation, the *EU Fusion Strategy* aims to address critical technological gaps through focused research and innovation, and by building a competitive industrial ecosystem, engaging the EU private sector and by focusing on a skilled workforce.

To realise this ambitious vision and establish fusion energy as a cornerstone of Europe's long-term energy strategy – while ensuring industrial leadership and market competitiveness – the EU must act decisively. A key recommendation is the establishment of an innovation ecosystem that encourages investment and promotes growth in the fusion sector to empower private industry to lead the development of a future pilot fusion power plant<sup>2</sup>. This may require adapting and harmonising regulatory frameworks, establishing technical standards, and creating guidelines to support the advancement of fusion installations. Additionally, this paper highlights the importance of strengthening international collaborations with trusted partners to accelerate shared technological advancements. To ensure reliability and measurable progress, it also emphasises the need for an effective EU-level decision-making process involving all relevant stakeholders.

Structured around **five key pillars**, the FEG Opinion Paper outlines essential priorities crucial for achieving the European Commission's broader objective of securing Europe's energy future and positioning EU as a global leader in fusion energy.



<sup>1</sup> [https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/euratom-research-and-training-programme\\_en](https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/euratom-research-and-training-programme_en)

<sup>2</sup> A pilot fusion power plant is a prototype power plant designed to demonstrate the feasibility of generating net electricity from fusion energy. It serves as an intermediate step between large-scale experimental reactors like ITER and fully commercial fusion power plants.

## 2. Pillar I. ITER – The way

ITER<sup>3</sup>, meaning “*The Way*” in Latin, is one of the most ambitious energy projects in the world. Described as a “*multinational scientific collaboration without precedent*”<sup>4</sup>, ITER brings together seven global partners: China, the European Union (EU), India, Japan, Korea, Russia, and the United States. The 2006 ITER Agreement<sup>5</sup> established the ITER Organisation<sup>6</sup> (IO) to manage and oversee the project’s implementation. As the host member, Europe is the major contributor to the initiative, contributing 45.4% of the construction costs, with the other six partners each providing 9.1%<sup>7</sup>.

ITER is the world’s first fusion experimental device of “*power plant level*” and serves as a cornerstone of the EU’s path to fusion energy. Its primary objective is to demonstrate the technical and scientific feasibility of fusion as a future source of carbon-free energy. ITER will also enable decisive progress in Technology Readiness Level (TRL) of crucial fusion technologies (such as superconducting magnets, remote maintenance, etc.) and partially validate tritium breeding module concepts that would lead to fuel self-sufficiency. The experience and know-how gained by its design, construction and overall operation will be essential towards the development of a commercially viable pilot fusion power plant.

### 2.1. ITER New Baseline (2024)

Significant progress has been achieved in the construction of ITER since the ITER Agreement’s entry into force in 2007. However, due to delays caused by technical challenges linked to the First-Of-A-Kind nature of many components and to some extent by the Covid-19 pandemic, the ITER Organisation together with the seven Domestic Agencies launched in July 2024 a revised ITER baseline<sup>8</sup> in terms of organisation, scope, schedule and costs. This updated the previous 2016 ITER baseline.

The 2024 baseline proposal incorporates knowledge gained in the worldwide fusion programme since the signature of the ITER Agreement and consolidates the assembly stages of ITER to achieve the quickest route to the Start of Research Operations (SRO), while avoiding technical and licensing risks. With more components installed and enhanced pre-assembly testing, the first phase (SRO) will already lead to a scientifically and technically robust operational campaign with more meaningful scientific results. According to this baseline, the first nuclear Deuterium-Deuterium (DD) operation should be reached in 2035, with no delay compared to the 2016 baseline. Deuterium-Tritium (DT) experiments are envisaged to start in 2039, and the achievement of ten-fold energy gain ( $Q \geq 10$ ) is foreseen in 2044, subject to the extension of the ITER Agreement, which expires in 2042.

The key importance of the ITER project for the industrialisation of fusion technology justifies its sustained technical, financial, and political support. ITER is crucial for the design and construction of future fusion power plants in the EU. These advancements present European high-tech industries and SMEs with opportunities for innovation and the creation of “*spin-off*” products for applications beyond fusion<sup>9</sup>.

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<sup>3</sup> <https://www.iter.org/fr>

<sup>4</sup> [https://ec.europa.eu/commission/presscorner/detail/en/ip\\_06\\_676](https://ec.europa.eu/commission/presscorner/detail/en/ip_06_676)

<sup>5</sup> <https://www.iter.org/sites/default/files/ITERAgreement.pdf>

<sup>6</sup> <https://www.iter.org/about/iter-organization>

<sup>7</sup> During ITER exploitation phase, the EU will remain the largest contributor among ITER Members, covering 34% of the operational costs, while other Members will contribute between 10 and 13%.

<sup>8</sup> <https://www.iter.org/node/20687/updated-baseline-presented>

<sup>9</sup> COM (2017) 319 final, Communication from the Commission to the European Parliament and the Council, EU Contribution to a reformed ITER project. <https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=COM:2017:0319:FIN>

Overall, these efforts will play a pivotal role in ensuring ITER's success and in laying the groundwork for the future of fusion energy.

#### FEG recommendations:

- **Continued Sustained Support to ITER:** Acknowledge the significance of ITER and support the European Commission's ongoing efforts to optimise and mitigate risks in the new 2024 ITER Baseline proposal.
- **Advance Towards a Pilot Fusion Power Plant:** In light of the new ITER Baseline announced in July 2024, it is essential to maintain progress towards the realisation of a pilot fusion power plant, ensuring the timely development of all required technologies and maintaining the expertise gained during the design and construction of ITER.
- **Promote Industry Collaboration and Technology Transfer:** It is important to actively foster collaboration with industry and the transfer of technologies developed by ITER, the Joint Undertaking 'Fusion for Energy' (F4E<sup>10</sup>), and the co-funded partnership EUROfusion<sup>11</sup>. Effective coordination should be ensured among the ITER programme and all fusion stakeholders to accelerate progress towards a pilot fusion power plant.

## 2.2. Preparation for ITER Operations

By the end of the next EU Framework Programme<sup>12</sup> for Research and Technological Development (FP10 i.e., 2028-2034 assuming a seven-year duration), ITER will have entered its operational phase. To maximise its potential and ensure the "value for money" for its share of contribution and significant investment, the EU must prepare to take a leading role in ITER operations. A unified and coordinated contribution to the ITER Organisation will enable EU laboratories and industries to fully capitalise on the outcomes of ITER's operations and advance the development of a pilot fusion power plant.

Equally important is the education and training of a new generation of scientists and engineers to support ITER's successful exploitation. The Start of Research Operations phase, foreseen in Autumn 2034 and expected to last two years, will require a fully trained experimental team to be prepared well in advance.

To ensure a successful transition to and execution of ITER operations, the EU must establish a robust foundation for coordinated participation, leveraging its unique set of experimental devices. A unified team approach, involving collaboration with F4E, EUROfusion, and the ITER Organisation, is essential. The *EU Fusion Strategy* will harness the EU's deep expertise in technology, experimentation, operations and simulations to maximise the effective exploitation of ITER, and reinforcing its role as a cornerstone of fusion energy development.

#### FEG recommendation:

- **Maximise EU Benefits in ITER Operations<sup>13</sup>:** The EU should ensure it is well-prepared and coordinated by actively engaging the entire EU fusion community in the preparation and execution of ITER operations. The EU should leverage the Euratom Research and

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<sup>10</sup> The Joint Undertaking 'Fusion for Energy' - F4E (<https://fusionforenergy.europa.eu/>) is the European Union's organisation responsible for managing Europe's contribution to the ITER project. F4E was established in 2007 and is headquartered in Barcelona, Spain.

<sup>11</sup> EUROfusion is a co-funded partnership with the European Commission (Grant Agreement N°101052200) that coordinates fusion energy research in Europe (<https://euro-fusion.org/>)

<sup>12</sup> [https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls\\_en](https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls_en)

<sup>13</sup> Operations here refers to the commissioning, nuclear operation, scientific exploitation and maintenance and upgrade activities of ITER.

Training Programme<sup>14</sup>, particularly through EUROfusion and F4E to maximise collaborative efforts. In this context, training and education fusion programmes, as well as the scientific exploitation of European fusion devices (tokamaks and stellarators) in operation and the facilities under the Broader Approach<sup>15</sup>, must be strongly supported. This will ensure that EU science and industry fully benefit from ITER's outcomes, paving the way for the design, construction, and operation of a future pilot fusion power plant.

## 3. Pillar II. Research, Innovation, and building a Competitive Industrial Ecosystem

### 3.1. A New EU Roadmap to a Pilot Fusion Power Plant

Since 2014, EUROfusion, a co-funded European partnership, has coordinated fusion research across 26 EU Member States under the Euratom programme. Its R&D roadmap<sup>16</sup>, which focuses on ITER, DEMO<sup>17</sup> and IFMIF-DONES<sup>18</sup>, with the stellarator as an alternative concept to the tokamak, has served as the foundation for fusion research in Europe. The roadmap includes extensive experimental campaigns and a sequential approach, with DEMO's construction planned after ITER. However, delays in ITER's timeline have extended the schedule for DEMO's design and construction, raising concerns about the viability of the sequential approach. While EUROfusion's roadmap has provided a valuable framework during the last decade, it requires a revision<sup>19</sup>. Key activities should continue, but a transformative approach is needed in specific areas to address the evolving landscape and the revised ITER timeline effectively.

Europe has developed world-leading expertise in magnetic confinement fusion (MCF), particularly through its work on tokamaks and stellarators. Tokamaks are currently the most advanced candidates for a future pilot fusion power plant, while stellarators offer inherent stability and continuous operation capabilities, making them a promising alternative for the commercialisation phase. In parallel with the mainstream MCF approach, a new assessment of alternative fusion concepts, such as inertial confinement<sup>20</sup>, should be conducted to evaluate their potential as commercially viable energy sources. This assessment should also consider their possible integration into a new EU roadmap as a risk-mitigation strategy. Additionally, synergies between different fusion concepts and shared technological solutions should be encouraged.

Advancing fusion commercialisation requires progress in low TRL technologies and development of a future pilot fusion power plant. Key areas include developing neutron resilient materials, tritium breeding and fuel cycle technologies, power exhaust systems, heat extraction mechanisms, and remote handling solutions. In this context, F4E, EUROfusion, and other EU fusion stakeholders should develop credible plans to advance each of these technologies to higher TRLs. A comprehensive risk analysis using TRL assessments for fusion-critical technologies should continue at the EU level. To accelerate this transition from research to industrial-scale

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<sup>14</sup> [https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/euratom-research-and-training-programme\\_en](https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/euratom-research-and-training-programme_en)

<sup>15</sup> [https://energy.ec.europa.eu/topics/research-and-technology/fusion-energy-and-iter/broader-approach\\_en](https://energy.ec.europa.eu/topics/research-and-technology/fusion-energy-and-iter/broader-approach_en)

<sup>16</sup> European Roadmap to the Realisation of Fusion Energy: <https://euro-fusion.org/eurofusion/roadmap/>

<sup>17</sup> <https://euro-fusion.org/programme/demo/>

<sup>18</sup> <https://ifmif-dones.es/>

<sup>19</sup> Summary report: Interim Evaluation of Euratom Fusion Program 2021-2025 and Ex-ante Assessment of Extension of Euratom Fusion Program 2026-2027 (internal EC document)

<sup>20</sup> Inertial confinement fusion (ICF) has garnered significant attention following the achievement of ignition at the National Ignition Facility in the US in 2022. Given this milestone, ICF merits full integration into the European Fusion Roadmap. The EU boasts a growing academic community, world-leading industries in optics and photonics, state-of-the-art laser facilities, and a promising ecosystem of start-ups in the field.

manufacturing ('Lab to Fab'), F4E and EUROfusion should drive this process forward, addressing all aspects, from fuel availability to the declassification of fusion facilities.

### FEG recommendations:

- **Position Fusion Energy as a Cornerstone of Long-Term Strategy:** To achieve this, the European Commission should urgently publish a communication on the *EU Fusion Strategy* to accelerate the transition from achieving energy gain in fusion to the commercialisation of fusion energy in the EU, alongside the next Multiannual Financial Framework<sup>21</sup>. This will ensure alignment with Europe's broader energy objectives, making Europe a strong, independent and leading global player in fusion energy.
- **Develop a Comprehensive European Fusion Roadmap Towards a Pilot Fusion Power Plant:** Building on the existing EUROfusion Roadmap and its Addendum, a new European Fusion Roadmap should be developed. With the contribution of EUROfusion, F4E and industry, this roadmap should take into account the new ITER baseline, the interim evaluation of the Euratom Work Programme 2021-25<sup>22</sup>, the future *EU Fusion Strategy*, the FEG recommendations, and build on the upcoming Strategic Research and Innovation Agenda<sup>23</sup> on Fusion Energy. It should establish key milestones, identify the necessary facilities, and outline the coordination mechanisms required to successfully achieve a commercial pilot fusion power plant.
- **Support Alternative Fusion Concepts:** such as Inertial Confinement Fusion (ICF). This would foster innovation and broaden the scientific understanding necessary for advancing fusion energy technologies. Other high-potential but high-risk concepts should be carefully evaluated. Opportunities to create synergies between different technological concepts should be leveraged wherever possible.
- **Conduct Rigorous Evaluation of Fusion Concepts:** Ensure that mature concepts for developing a pilot fusion power plant undergo thorough and comprehensive evaluation<sup>24</sup> in view of limited funding available to support the chosen approach. This process should assess its scientific and technical feasibility, its economic and industrial viability, and overall business case to identify the most promising pathways for the fusion energy market. This pilot project will have to be designed, budgeted, and constructed in the EU under the leadership of EU industry, integrating the expertise and capabilities of fusion research organisations.
- **Establishing the Path to a Commercial Fusion Power Plant:** To enable the development of a fully commercialised fusion power plant, a structure process must be established to develop and demonstrate the required technologies needed during the pilot phase.

## 3.2. Promoting Industry Partnership and Innovation

The EU private sector involved in fusion energy can primarily be divided into two main groups:

- **Established Companies:** whether large or small, that have primarily contributed as suppliers to fusion projects such as ITER, W7-X<sup>25</sup>, DTT<sup>26</sup>, JT-60SA<sup>27</sup> and IFMIF-DONES<sup>28</sup>

<sup>21</sup> <https://www.europarl.europa.eu/factsheets/en/sheet/29/multiannual-financial-framework>

<sup>22</sup> <https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52025SC0054>

<sup>23</sup> <https://cordis.europa.eu/project/id/101212737>

<sup>24</sup> by a group of different stakeholders i.e., public institutions, private companies and investors, research organisations.

<sup>25</sup> <https://www.ipp.mpg.de/w7x>

<sup>26</sup> <https://www.dtt-project.it/>

<sup>27</sup> <https://www.it60sa.org/wp/>

<sup>28</sup> <https://ifmif-dones.es/>

and others. Over the past 15 years, the EU has provided significant support to these companies, primarily by fostering the development of the fusion industry supply chain.

- **Fusion Start-Ups:** Emerging, high-risk companies focused on rapid growth. Although fewer in Europe<sup>29</sup> compared to the US, these start-ups are exploring tokamak and alternative fusion approaches to accelerate industrialisation and commercialisation of fusion energy. They also aim to commercialise products in the short term, attracting substantial private funding despite having limited connections to ITER.

Given this evolving landscape, there is a need for policy adjustments to effectively guide the efforts of EU institutions and Member States.

One of the core activities of F4E has been to contract with industries and research organisations for the delivery of the EU contributions to ITER construction and the Broader Approach. Since 2007, F4E has placed over 1200 contracts for a value of over EUR 7 billion. With the support of its Governing Board, F4E launched a call for expression of interest towards EU based private fusion initiatives in autumn 2024 and is seeking opportunities for collaboration.

The European Commission's March 2024 study<sup>30</sup>, the Draghi<sup>31</sup> report and the recent European Parliament<sup>32</sup> debate on fusion energy highlight the need for a comprehensive EU fusion innovation strategy and a public-private partnership (PPP) to fast-track fusion commercialisation. As recommended, the EU should pursue various approaches acting in coordination to address key fusion technology challenges and the European private funding gap, such as the establishment of a fusion PPP and activating existing instruments like the F4E Innovation Partnership<sup>33</sup> and Technology Development Programme<sup>34</sup>. To achieve this, the European Commission will build on the results of the Euratom Coordination and Support Action (CSA<sup>35</sup>) to be realised in 2025 and 2026 to create a collaborative environment for a future fusion PPP through an EU Fusion Industry-led association, representing the European fusion industry and relevant other fusion-related technology centres, F4E and research organisations with a view to a possible evolution into a long-term European Technology and Innovation Platform (ETIP), institutionalised in the framework of the SET Plan<sup>36</sup>. This initiative will focus on building a stable ecosystem for industrial innovation, defining a clear Strategic Research and Innovation Agenda (SRIA) to support EU industry in mastering relevant fusion technologies and establishing a competitive EU supply chain for a pilot fusion power plant as well as for ITER's completion and operation.

The European Commission should also support breakthrough innovations through the European Innovation Council (EIC<sup>37</sup>) to accelerate fusion energy's transition from research to industrialisation. The European Commission should propose expanding its scope to include research proposals towards fusion energy applications. This bottom-up approach focused on projects with lower TRL, will complement the fusion PPP and support concepts not covered by the SRIA.

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<sup>29</sup> e.g., Emerging private fusion startups in Europe include (but are not limited to) Renaissance Fusion, GenF in France; Gauss Fusion, Proxima Fusion, Focused Energy and Marvel Fusion in Germany; Deutelio in Italy; and Novatron Fusion in Sweden.

<sup>30</sup> [https://energy.ec.europa.eu/news/new-commission-study-potential-public-private-partnership-approach-foster-innovation-fusion-energy-2024-03-07\\_en](https://energy.ec.europa.eu/news/new-commission-study-potential-public-private-partnership-approach-foster-innovation-fusion-energy-2024-03-07_en)

<sup>31</sup> [https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead\\_en](https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead_en)

<sup>32</sup> European Parliament plenary session in Strasbourg: [Sitting of 20-01-2025 | Plenary | European Parliament](#)

<sup>33</sup> <https://fusionforenergy.europa.eu/news/f4e-call-for-expression-of-interest-boosts-collaboration-with-private-fusion-enterprises/>

<sup>34</sup> <https://fusionforenergy.europa.eu/news/f4e-eurofusion-technology-transfer-launch/>

<sup>35</sup> <https://cordis.europa.eu/project/id/101212737>

<sup>36</sup> [https://energy.ec.europa.eu/topics/research-and-technology/strategic-energy-technology-plan\\_en](https://energy.ec.europa.eu/topics/research-and-technology/strategic-energy-technology-plan_en)

<sup>37</sup> [https://eic.ec.europa.eu/index\\_en](https://eic.ec.europa.eu/index_en)

Lastly, to maintain private sector interest, the EU must focus on moving from research to industrialisation. ITER alone could not suffice and the needs for additional critical research infrastructures should be explored.

#### FEG recommendations:

- **Enhance EU Private Sector Engagement through a Public-Private Partnership (PPP):** Broad private sector participation in fusion energy should be actively promoted, fostering the transition of private entities from suppliers to key players. A fusion PPP should be established, aligning with the new European fusion roadmap and supported by a Strategic Research and Innovation Agenda and based on ongoing Technology Readiness Level analysis. In collaboration with F4E, the ITER Organisation, and EUROfusion, private companies — including startups and established firms — should contribute to overcoming technology challenges that ITER will not address in time for the early construction of a pilot fusion power plant. Strengthening and expanding existing initiatives such as the F4E Innovation Partnership and Technology Development Programme will further accelerate the scaling of essential fusion technologies, driving commercialisation efforts.
- **Dedicated Support for Start-Ups:** A dedicated Challenge<sup>38</sup> for start-ups in collaboration with the European Innovation Council (EIC) should be created. This bottom-up approach should follow rigorous scientific evaluation of the viability and technological progress of start-up concepts fostering innovation. F4E should also continue to explore opportunities for collaboration.
- **Invest in Fusion Infrastructure:** The development and construction of key facilities such as IFMIF-DONES should be supported. The need for additional infrastructures or upgrades to existing ones to develop, test, and validate key integrated technologies in a fusion-relevant environment should be assessed. Additionally, the potential development and construction of new infrastructures for alternative fusion concepts, such as Inertial Confinement Fusion, should also be assessed.

### 3.3. European Supply Chain

The EU's industrial fusion ecosystem has been steadily developing, largely driven by the ITER project. F4E has gained a unique and extensive insight into the EU fusion supply chain by mapping contractors during procurement processes. However, significant technological gaps remain beyond ITER. Solutions must be found and tested to address these challenges, including issues related to the fuel cycle, remote handling, heating and control for various fusion concepts.

Additionally, European companies are at the forefront of manufacturing and developing key components for fusion reactors. The advancement of fusion energy offers significant market opportunities outside field, driving growth in related sectors such as materials science, advanced manufacturing, and energy storage. By integrating fusion into its high-tech strategy, the EU can capitalise on these benefits, fostering innovation and creating jobs across multiple industries.

A clear and unified path forward and targeted strategic investment are essential to ensure the efficient identification and delivery of the necessary technological components. To further strengthen the European supply chain and close the critical technology gaps, it is crucial to identify key stakeholders in Europe who can act as integrators — coordinating the construction and operation of a future pilot fusion power plant.

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<sup>38</sup> [https://eic.ec.europa.eu/eic-funding-opportunities/eic-accelerator/eic-accelerator-challenges-2025\\_en](https://eic.ec.europa.eu/eic-funding-opportunities/eic-accelerator/eic-accelerator-challenges-2025_en)

This leadership role should be taken on by industry, in close coordination with investors and key fusion stakeholders such as F4E and EUROfusion. This approach will help accelerate the industrialisation of fusion energy and support its transition from research labs to commercial manufacturing ('*Lab to Fab*').

Additionally, the EU must address the shortage of essential fuel sources, including tritium and the enrichment of lithium-6, to safeguard its autonomy and leadership in the global energy sector. Ensuring a stable and secure supply of these resources is vital for advancing fusion energy technology and reducing dependence on external suppliers.

#### FEG recommendations:

- **Foster Cooperation for Global Leadership:** Close cooperation between the private sector, ITER, F4E, EUROfusion and inertial confinement fusion stakeholders should be promoted to ensure the EU secures a strong and sustained position in the global fusion supply chain.
- **Strengthen the European Fusion Supply Chain:** Mechanisms to build and enhance the European fusion supply chain and related technologies for a pilot fusion power plant should be developed.
- **Address Critical Strategic Issues:** The shortage of essential fuel sources such as tritium and the enrichment of lithium-6 should be addressed, to ensure the EU's autonomy, competitiveness and leadership.

### 3.4. Technology and Knowledge Transfer

Effective technology and knowledge transfer programmes are essential for creating a sustainable innovation ecosystem. These programmes foster the development of new products, services, and spin-off businesses based on breakthroughs in emerging markets, while promoting cross-sector collaboration to turn scientific advances into innovative products and manufacturing processes.

To strengthen collaboration with industry and protect Intellectual Property Rights (IPR) in the EU, it is crucial to implement technology transfer activities efficiently. F4E and EUROfusion are already working closely on technology transfer to maximise the impact of fusion research, optimise knowledge utilisation, and generate significant socio-economic benefits. These efforts should continue as they are essential for translating fusion research into tangible industrial and economic benefits, including the development of a competitive EU fusion supply chain.

#### FEG recommendations:

- **Leverage EU Instruments for Technology Transfer:** The Euratom work programme should make use of all relevant EU instruments, including the European Research Council (ERC<sup>39</sup>) and the European Innovation Council (EIC), to effectively transfer fusion research and innovations to the market. It should also consider the EIC Forum's recommendations<sup>40</sup> to support successful commercialisation.
- **Foster Technology and Knowledge Transfer:** Investment in the active valorisation and adoption of fusion technologies should be encouraged by establishing a robust, bi-directional technology and knowledge transfer programme building on the joint work of F4E and EUROfusion. This programme should facilitate collaboration between the

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<sup>39</sup> <https://erc.europa.eu/homepage>

<sup>40</sup> [https://research-and-innovation.ec.europa.eu/news/all-research-and-innovation-news/eic-forum-presents-its-recommendations-close-europes-innovation-gap-2025-02-07\\_en](https://research-and-innovation.ec.europa.eu/news/all-research-and-innovation-news/eic-forum-presents-its-recommendations-close-europes-innovation-gap-2025-02-07_en)

fusion industry (encompassing both magnetic and inertial fusion approaches), other research fields, and non-fusion industries, in particular that of fission industry.

- **Encourage Staff Exchanges and Promote IPR Awareness:** Staff exchanges between academic and non-academic organisations should be supported to drive innovation and enhance knowledge transfer. Special emphasis should be placed on raising scientists' awareness of Intellectual Property Rights (IPR) and implementing systematic processes to review the IPR content of new projects during their early development stages.

### 3.5. Skilled Workforce, Education and Training

A skilled workforce is essential to achieving the goal of a pilot fusion power plant in the EU. The availability of qualified personnel is directly linked to progress in the fusion sector.

EUROfusion's Education and Training initiatives support early-career researchers and engineers through programmes such as Master and PhD courses, FuseNet<sup>41</sup>, EUROfusion Engineering Grants<sup>42</sup> (EEG), and the “Bernard Bigot” Researcher Grants<sup>43</sup> (ERG). These programmes cover topics such as plasma physics, nuclear engineering, and the operation of tokamaks and stellarators. They should also include inertial confinement fusion, as well as laser and optics engineering.

To enhance the attractiveness of the EU fusion sector and promote workforce mobility, it is essential to retain and expand its skilled talent pool by fostering innovation and creating exciting career opportunities. Meeting the growing demand for engineers — particularly those specialising in tokamak and systems design — will be crucial for advancing fusion energy and ensuring the EU remains a global leader in fusion research.

To address these issues and to support ITER, it is vital to strengthen the engineering capacity of the EU fusion community and collaborate with industry. The European Commission must ensure the new roadmap includes strategies to attract, train, and retain a highly skilled fusion workforce, including scientists, engineers, and technicians. This should involve updating educational curricula and fostering the enthusiasm that has long driven the EU's fusion sector.

Additionally, preserving and sharing the knowledge accumulated so far is crucial for future generations. The strategy should also focus on expanding and diversifying the fusion workforce, with a commitment to gender equality, diversity, and inclusion.

#### FEG recommendations:

- **Develop a Comprehensive Workforce Strategy:** Together with F4E, EUROfusion the ITER Organisation and inertial confinement fusion stakeholders, a robust strategy should be designed and implemented to attract, train and retain a skilled fusion workforce — including scientists, engineers, and technicians — within the EU. This strategy should focus on:
  - Enhancing the attractiveness of fusion careers
  - Promoting diversity and inclusion
  - Career planning and development
  - Promoting cross-sector and cross-border mobility
  - Supporting skills transferability and digital competenciesThe future fusion PPP should play a pivotal role in bridging gaps between public research, academic institutions, and industry, fostering technological innovation alongside workforce development.

<sup>41</sup> The European Fusion Education Network: <https://fusenet.eu/>

<sup>42</sup> <https://euro-fusion.org/eurofusion-news/2025eeg/>

<sup>43</sup> <https://euro-fusion.org/eurofusion-news/erg25open/>

- **Establish a Long-Term EU Training Programme:** A stable, EU-funded training programme should be created that is accessible across all Member States, encouraging mobility and emphasising gender and geographic diversity. This programme should focus on cultivating the next generation of STEM (science, technology, engineering, and mathematics) graduates, with undergraduate courses adapted to address the complexities of fusion technology. Building on existing fusion expertise and ensuring its availability to future generations across the EU is essential to sustaining progress in this field.
- **Enhance Inclusion in ERA Widening Participation Programme:** Fusion scientists from widening countries<sup>44</sup> should be granted the opportunity to participate in initiatives under the “Widening Participation and Strengthening the European Research Area<sup>45</sup> (ERA)” programme, including all ERA fellowships from which they are currently excluded, as are fission scientists. Their inclusion should be extended to future programmes aimed at widening participation and strengthening the ERA. Particular attention should be given to exploring synergies with researchers specialised in nuclear fission.

## 4. Pillar III. Fusion Regulatory Framework

Currently, no country has a comprehensive, fusion-specific regulatory framework<sup>46</sup>. Regulatory approaches differ across nations. A harmonised regulatory framework within the EU would accelerate fusion technology development and commercialisation, it will facilitate the adoption of fusion markets by investors and promote innovation. Regulatory transparency would also foster public acceptance, which is crucial for successful technology deployment.

A unified regulatory approach would streamline licensing processes, optimising both time and costs. It should be proportional to the risks associated with fusion, taking into account the evolving nature of the technology. As fusion has not yet reached the demonstration phase, the regulatory framework would benefit from more operational experience and safety data. The risks involved may also vary depending on the specific technology and design.

While a fully developed regulatory framework for pilot fusion power plants is not immediately necessary, it is crucial with respect to regulatory certainty to establish clear guidelines on key regulatory principles for developers, operators, and regulators. Early identification of these principles is mandatory to facilitate the timely creation of targeted codes and standards and cope with the race already initiated by governments willing to pave the way on standards (in USA, UK, China, etc.).

To ensure regulatory certainty, discussions should begin on an EU legal framework, drawing on insights from existing fusion facilities such as JET<sup>47</sup> and ITER, as well as ongoing work by the International Atomic Energy Agency (IAEA<sup>48</sup>), other international partners and fusion industry.

<sup>44</sup> [https://rea.ec.europa.eu/horizon-europe-widening-who-should-apply\\_en](https://rea.ec.europa.eu/horizon-europe-widening-who-should-apply_en)

<sup>45</sup> [https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/widening-participation-and-spreading-excellence\\_en](https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/widening-participation-and-spreading-excellence_en)

<sup>46</sup> <https://op.europa.eu/en/publication-detail/-/publication/e1579af9-8d44-11ec-8c40-01aa75ed71a1/language-en>

<sup>47</sup> <https://ccfe.ukaea.uk/programmes/joint-european-torus/>

<sup>48</sup> <https://www.iaea.org/>

## FEG recommendations:

- **Engage in Comprehensive Stakeholder Dialogue:** Collaborate with key stakeholders, including national regulatory authorities, Technical and Scientific Support Organisations, and the Western European Nuclear Regulators' Association (WENRA<sup>49</sup>). Include wider countries expertise. Prioritise engagement with national regulatory authorities through the European Nuclear Safety Regulators Group (ENSREG<sup>50</sup>), with the potential to establish a dedicated group of interested authorities within ENSREG. In addition, the fusion industry should be consulted to evaluate the effectiveness of the discussed framework. The dialogue should aim to:
  - a. **Establishing Regulatory Criteria:** Within the framework for European cooperation established by the Euratom Treaty<sup>51</sup>, determine whether specific criteria, such as the tritium inventory, should underpin the regulatory approach. These criteria would help address variations in radiological hazard potential across diverse fusion technologies and designs. To establish regulatory criteria attention should be given to the definition of 'Fusion Facility' and/or 'Fusion Power Plant', possibly aligning with international standards<sup>52</sup>.
  - b. **Discussing Fusion-Specific Safety Requirements:** Identify and clarify safety requirements unique to fusion facilities, encompassing both Magnetic Confinement Fusion (MCF) and Inertial Confinement Fusion (ICF). Specifying whether these requirements are similar or different from those governing fission, while exploring lessons learned from fission safety practices and evaluating how this knowledge can be adapted to enhance fusion safety standards.
  - c. **Analysing Risk Profiles of Existing Fusion Facilities:** Evaluate the risk profiles of current fusion facilities licensed as particle accelerators, as nuclear installations (in the case of ITER) or under comparable frameworks. Identify future facilities that could adopt similar regulatory approaches and assess those requiring additional measures due to higher risk profiles or increased technological complexity. Investigate the feasibility of applying a graded approach to safety analyses and licensing, tailored to the specific characteristics of various fusion technologies.
  - d. **Strengthening Non-proliferation Measures:** This may be achieved through international cooperation and existing frameworks to assess whether potential proliferation risks associated with fusion technology — such as diversion of tritium or lithium-6, misuse of advanced ICF knowledge and related simulation capabilities, or use of fusion devices for fissile material breeding, or misuse of dual purpose technologies for isotopic separation — are properly addressed (e.g., by the dual use export control regime in place<sup>53</sup>) or whether it should be enhanced, such as through 'controls-by-design'.
  - e. **Addressing Liability Issues in the Nuclear Sector:** Examine how the current liability regime might hinder the deployment of commercial fusion. Involve nuclear sector experts and gather feedback from nuclear power plant operators to identify possible solutions.
  - f. **Establishing a Common European regulatory approach in the short-term, under the framework of Euratom Treaty:** A potential EU legal framework for fusion is a long-term goal — aimed at overseeing future fusion power plants with potentially higher risk profiles than current facilities — a coordinated approach is needed in the

<sup>49</sup> <https://www.wenra.eu/>

<sup>50</sup> <https://www.ensreg.eu/>

<sup>51</sup> <https://www.europarl.europa.eu/about-parliament/en/in-the-past/the-parliament-and-the-treaties/euratom-treaty>

<sup>52</sup> IAEA TECDOC No. 2076, <https://www.iaea.org/publications/search/topics/fusion/type/tecdoc-series> provides terminology for concepts such as 'fusion facility,' 'fusion power plant,' and 'fusion device.'

<sup>53</sup> INFCIRC/254, Part 2

short-term. To provide regulatory clarity and certainty for stakeholders planning to build prototype or research facilities in Europe, a common understanding of the applicable European directives should be established and consistently supported across Member States. This would streamline the licensing process of fusion facilities ahead of the potential development of a new regulatory framework.

- **Monitor International Efforts:** Maintain close alignment with ongoing international initiatives, particularly those led by the IAEA, to guide and support the development of an EU-specific legal framework for fusion.
- **Explore International Cooperation Frameworks:** Investigate opportunities for collaboration between European regulators and their counterparts in the US and other interested countries. Promote the exchange of best practices in the regulation and licensing of fusion-related facilities and systems, with an additional focus on engaging with standardisation bodies to support global harmonisation.

## 5. Pillar IV. International Cooperation

The international fusion research community has a strong tradition of collaboration through multilateral and bilateral partnerships, with the EU playing a central role. Many countries have developed advanced technologies and research facilities that are shared on a mutually beneficial basis.

To accelerate the commercial deployment of fusion energy, it is essential to establish targeted collaborations with international partners, guided by the upcoming Strategic Research and Innovation Agenda (SRIA). Joint efforts with international partners are crucial for overcoming technical challenges, establishing supply chains, and building the skilled workforce needed for commercialisation. However, the EU must also consider the evolving geopolitical landscape and focus on mutual benefits, while safeguarding the EU's sovereignty, leadership, and competitiveness. Recent examples of cooperation and competition in fusion energy developments among international partners underline the urgency to prepare a safe EU fusion supply chain<sup>54</sup>.

In recent years, the fusion energy ecosystem has been rapidly evolving, driven by global collaboration and increasing private sector engagement. New global initiatives offer opportunities for the EU to bridge knowledge gaps, accelerate technology development, and address challenges more effectively, especially where there is clear added value for the EU.

### FEG recommendations:

- **Promote Strategic International Cooperation:** The European Commission should continue fostering strong international partnerships with selected countries in addition to the Union's membership in ITER. These partnerships should prioritise enabling technologies critical for fusion development while safeguarding EU sovereignty, leadership and competitiveness. Efforts should also focus on upskilling Europe's workforce to meet future demands.
- **Map Programme Gaps and Propose Collaboration Schemes:** In coordination with governance structures and partnerships outlined in other pillars of this paper, the European Commission should identify gaps in the EU fusion programme. It should propose mutually beneficial collaboration schemes with international partners,

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<sup>54</sup> <https://www.gov.uk/government/publications/fusion-energy-collaboration-joint-uk-us-statement/joint-statement-between-the-uk-and-the-us-on-a-strategic-partnership-to-accelerate-fusion-energy-demonstration-and-commercialisation>

emphasising intellectual property management, knowledge exchange, and technology development. Particular attention should be given to strengthening education and training initiatives for students, early-career researchers, and nuclear fission experts, while ensuring inclusivity for underrepresented and less -developed regions worldwide and benefitting from actions under Horizon Europe's part on widening participation and strengthening the European Research Area (ERA).

- **Third-Country Association to the Euratom R&T Programme:** The European Commission should remain open to associating third countries with advanced nuclear research programmes to the Euratom Research and Training (R&T) Programme, in line with the requirements of the establishing regulation. Priority should be given to countries previously associated with the Euratom fusion joint programme (e.g., Switzerland<sup>55</sup>, Norway, Ukraine and the United Kingdom) and Horizon Europe-associated countries with advanced nuclear programmes. Such associations will facilitate access to third-country infrastructures and experiments in areas where EU-based capabilities are unavailable.
- **Strengthen Bilateral Agreements:** The European Commission should continue and strengthen active cooperation under existing agreements with countries, such as China<sup>56</sup> (e.g., CFETR-DEMO and BEST), Japan (e.g., Broader Approach<sup>57</sup> and fusion bilateral agreements), Republic of Korea<sup>58</sup> (e.g., TBM), and USA<sup>59</sup> (e.g., ICF and laboratory collaborations). Efforts should also be made to foster cooperation with Brazil<sup>60</sup>, Canada<sup>61</sup> (e.g., fuels technologies and materials), India<sup>62</sup>, Kazakhstan<sup>63</sup>, and other countries where there is a clear strategic interest and mutual benefit. Such collaborations should be regularly assessed to ensure their continued value.
- **Engage the Private Sector:** The European Commission should encourage stronger involvement of the EU private sector in international cooperation based on mutual benefits. Maintaining EU sovereignty, leadership, and competitiveness is paramount.

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<sup>55</sup> [https://research-and-innovation.ec.europa.eu/strategy/strategy-research-and-innovation/europe-world/international-cooperation/bilateral-cooperation-science-and-technology-agreements-non-eu-countries/switzerland\\_en](https://research-and-innovation.ec.europa.eu/strategy/strategy-research-and-innovation/europe-world/international-cooperation/bilateral-cooperation-science-and-technology-agreements-non-eu-countries/switzerland_en)

<sup>56</sup> Agreement between the European Atomic Energy Community and the Government of the People's Republic of China for R&D Cooperation in the Peaceful uses of Nuclear Energy; [https://www.eeas.europa.eu/sites/default/files/r\\_d-pune\\_agreement\\_en.pdf](https://www.eeas.europa.eu/sites/default/files/r_d-pune_agreement_en.pdf)

<sup>57</sup> Agreement between the European Atomic Energy Community and the Government of Japan for the Joint Implementation of the Broader Approach Activities in the field of fusion energy research; <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A22007A0921%2801%29>

<sup>58</sup> Agreement for cooperation between the European Atomic Energy Community represented by the Commission of the European Communities and the Government of the Republic of Korea in the field of fusion energy research; <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A22011A0611%2801%29>

<sup>59</sup> Agreement for cooperation between the European Atomic Energy Community represented by the Commission of the European Communities and the Department of Energy of the United States of America in the field of fusion energy research and development; <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A22001A0601%2801%29> ; Agreement for cooperation in the peaceful uses of nuclear energy between the European Atomic Energy Community and the United States of America; <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A21996A0520%2801%29>

<sup>60</sup> Agreement for cooperation between the European Atomic Energy Community and the Government of the Federative Republic of Brazil in the field of fusion energy research; [https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex:22010A0915\(02\)](https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex:22010A0915(02))

<sup>61</sup> Agreement between Canada and the European Atomic Energy Community for cooperation in the area of nuclear research; <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A21998A1222%2801%29>

<sup>62</sup> Agreement for cooperation between the European Atomic Energy Community and the Government of the Republic of India in the field of fusion energy research; [https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:22010A0915\(01\)&from=EN](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:22010A0915(01)&from=EN)

<sup>63</sup> Agreement for cooperation between the Government of the Republic of Kazakhstan and the European Atomic Energy Community in the field of controlled nuclear fusion; [https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:22005A0607\(01\)](https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:22005A0607(01))

The fusion PPP is expected to play a key role in ensuring EU-added value in these international collaborations.

## 6. Pillar V. Revised Governance

Since the dissolution of the Consultative Committee for the fusion programme (CCE-FU<sup>64</sup>), no single body has overseen the entire European fusion sector. Information exchange and coordination occur across various committees, with responsibilities shared between national laboratories and supra-national entities such as EUROfusion, F4E and the European Commission. While the European Commission funds F4E and co-finances the EUROfusion grant, much of the fusion budget is managed at the national level.

For effective progress in fusion energy, close coordination of schedules and resources is essential. A clear European governance structure is needed to guide strategic discussions and decision-making, involving stakeholders from science, industry, and beyond. As we move toward a pilot fusion power plant phase, this structure must evolve to meet new demands.

Overall, the governance framework must clarify roles, avoid redundancies, and establish flexible operating rules for timely progress.

### 6.1. Role of the European Commission

The European Commission (EC) plays a pivotal role in strengthening the strategic governance of European fusion activities. It should continue to oversee Euratom research initiatives, represent Euratom in fusion governing bodies, and provide critical administrative, policy, technical, and financial support to the EU's fusion efforts.

Through its leadership and coordination, the EC ensures that Europe's fusion activities remain cohesive, innovative, inclusive with all EU and associated countries, and strategically aligned with the EU's long-term energy objectives.

To ensure the development of an EU resilient energy market, the EC should provide a strong political engagement to support and protect the EU-based industry, competencies and technologies in fusion energy and build a strong framework to:

- ensure strategic investment capacity in EU and associated countries;
- build international regulatory frameworks and codes of practice in fusion energy;
- develop resilient supply chains for fusion materials to support the EU industry long-term;
- adopt policy measures to address strategic dependencies;
- develop a flexible and supportive state aid framework for enabling emerging fusion technologies.

#### Key responsibilities of the European Commission (EC) should include:

- **Steering and Coordination:** The EC should continue to ensure the alignment of fusion activities with broader EU policies and funding priorities. It will also facilitate closer integration of key stakeholders, including F4E, EUROfusion, industry, and Member States, actively engaging them in implementing the *EU Fusion Strategy*.
- **Integration and Collaboration:** To enhance the effectiveness of fusion governance, the EC should promote a collaborative model by improving coordination and integration

<sup>64</sup> <https://eur-lex.europa.eu/legal-content/SL-EN/TXT/?uri=CELEX:52003PC0149>

among Euratom committees involved in fusion activities, such as those overseeing ITER and the Euratom Research and Training (R&T) programme.

- **Strategic Relevance:** The EC must ensure that the *EU Fusion Strategy* remains focused on demonstrating the feasibility of fusion technologies and in the design, construction and operation of future (pilot) fusion power plants, monitoring strategic dependencies in the development of key technologies.

## 6.2. Role of the Fusion Expert Group and Member States

In 2024, the EC established the Commission Fusion Expert Group (FEG), comprising representatives from Member States and chaired by the EC, with EUROfusion and F4E participating as observers. Currently, the FEG's mandate focuses on enhancing EU-level fusion Research and Innovation (R&I) governance by providing advice on implementing the Euratom R&T Programme and ITER research activities.

While this serves as a short-term solution, the European Commission proposes to evolve the FEG into a *European Fusion Coordination Committee* (EFCC) to oversee the implementation of the *EU Fusion Strategy* and enhance coordination among the European Commission, Member States, and key stakeholders. The EFCC could foster synergies across initiatives, support EU fusion market objectives<sup>65</sup>, and provide strategic advice, including on the potential extension of the Euratom R&T Programme for 2026–2027. Each Member State should nominate a representative from its Ministry or Funding Agency, supported by a fusion expert.

### Key roles of a new European Fusion Coordination Committee (EFCC) should include:

- **Enhanced Coordination & Strategic Overview:** Act as a stable framework responsible for monitoring the implementation of the *EU Fusion Strategy*, ensuring coherence between the European Commission and Member States and key stakeholders such as F4E, EUROfusion, and the European Fusion Stakeholder Platform<sup>66</sup> (EFSP). Facilitate the coordination with the national stakeholders to streamline execution and optimise resources.
- **Streamlined Governance:** Simplify fusion governance by integrating the functions of the Euratom Programme Committee for fusion into the EFCC under the next Multiannual Financial Framework. This consolidation would improve coordination and efficiency.

## 6.3. Role of Fusion for Energy

Fusion for Energy (F4E) is a Euratom Joint Undertaking established in 2007 by the Council of the EU<sup>67</sup>. In December 2023, F4E's Governing Board, which oversees decisions and approves work programmes, endorsed a vision for F4E<sup>68</sup> elaborating in more detailed its missions, reinforcing several dimensions and including for example the mandate to support a stronger involvement of the fusion private sector in Europe. Three main lines of action were identified:

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<sup>65</sup> The fusion potential market is estimated by Sifted to be around USD 40 trillion globally: <https://www.bloomberg.com/professional/insights/trading/nuclear-fusion-market-could-achieve-a-40-trillion-valuation/>

<sup>66</sup> Cf section 6.5. Role of the European Fusion Stakeholder Platform

<sup>67</sup> Council Decision of 27 March 2007 establishing the European Joint Undertaking for ITER and the Development of Fusion Energy and conferring advantages upon it: <https://eur-lex.europa.eu/eli/dec/2007/198/oj/eng>

<sup>68</sup> F4E Vision, Endorsed by the Governing Board on 4-5 December 2023, F4E\_D\_35E7E5

1. Commit as top priority to the EU's contribution to the successful construction and operation of the ITER, Broader Approach, IFMIF-DONES and other fusion projects;
2. Develop the fusion talent and knowledge base for the future development of commercially viable fusion power plants in Europe;
3. Pave the way for a transition from the research to the industrial sector, and the creation of a competitive European industrial fusion sector.

Among the new initiatives, F4E was mandated to support a stronger involvement of the fusion private sector in Europe, including possible incentivising programmes and maximisation of return of investment. By effectively fulfilling its mandate, F4E will bolster Europe's global leadership in fusion and ensure timely delivery of the technologies needed to achieve fusion energy goals.

#### Key strategic priorities for F4E should include:

- **Building Foundations:** F4E should lead or support the establishment of foundational elements, including the supply chain and key technologies, in collaboration with the industry. These foundations are essential for designing and constructing a future pilot fusion power plant.
- **Enhancing Coordination:** As the entity responsible for Europe's contribution to ITER construction and exploitation, and other fusion-related projects, it is recommended that F4E, EUROfusion and the future fusion public private partnership (PPP) be closely aligned to minimise redundancy, enhance collaboration, and maximise synergies across programmes.

## 6.4. Role of EUROfusion

EUROfusion is a key research consortium driving Europe's progress in fusion energy. The European Commission's financing decision for the EUROfusion grant is subject to the opinion of the Euratom Programme Committee, in accordance with comitology rules. The consortium's decisions are made by its General Assembly, the highest decision-making body, which includes representatives from all participating Research Units.

#### Key areas for EUROfusion's strategic development should include:

- **Revising the Partnership:** EUROfusion's role and programme should be redefined in line with the future emerging *EU Fusion Strategy*. This includes leading its scientific agenda and focusing on the joint exploitation and operation of existing and future research infrastructures in the EU and around the world (e.g., WEST, ASDEX Upgrade, JT60-SA, ITER, IFMIF-DONES, DTT, W7-X, COMPASS-U), the JET data centre, as well as on foundational science and technology. This effort should primarily focus on activities with a low level of technological maturity. Additionally, EUROfusion aims to support ITER operation, the development of a future pilot fusion power plant, as well as exploring alternative and emerging fusion concepts (notably, such as the stellarator and inertial confinement fusion).
- **Promoting Industry Collaboration:** Strengthen interactions with the industry within the framework of the future fusion public private partnership (PPP). This will help address critical gaps in key technologies and foster innovation.
- **Building a Skilled Workforce:** EUROfusion should continue to prioritise the attraction, training and education, and retention of the fusion workforce, including scientists, engineers, and technicians. It should establish and provide high qualified scientific personnel for research and scientific exploitation of ITER and its supporting infrastructure. Ensuring the EU has a robust talent pipeline with the necessary expertise will be critical to achieving fusion energy objectives.

## 6.5. Role of the European Fusion Stakeholder Platform

The integration of industry is vital to Europe's fusion energy strategy. Industrial partners are expected to evolve from being primarily suppliers to taking a more central role in shaping and implementing future advancements. Their potential contributions could encompass providing essential engineering expertise, supporting commercialisation, scaling innovations, and enabling breakthroughs through public-private partnerships (PPPs). By combining public funding with private investment, these efforts aim to diversify approaches, share risks, and enhance market impact.

To facilitate and strengthen this collaboration, the European Commission will establish an industry-led European Fusion Stakeholder Platform (EFSP). This platform will represent the European fusion industry alongside relevant technology centres and research organisations. Over time, the EFSP could evolve into a European Technology and Innovation Platform (ETIP), which will provide long-term strategic direction for fusion energy innovation.

### Key objectives of the European Fusion Stakeholder Platform (EFSP) should include:

- **Collaborative Forum:** It should serve as an extended forum for all EU fusion stakeholders to discuss industry's role in accelerating progress and shaping the future fusion public-private partnership (PPP).
- **Strategic Leadership:** It should define the Strategic Research and Innovation Agenda for advanced Technology Readiness Level fusion technologies, guiding the priorities and calls of the future fusion PPP.
- **Governance and Frameworks:** It should lay the groundwork for a robust intellectual property framework, foster technology transfer and contribute to the governance of EU fusion activities.

## 6.6. Funding Strategies and Support

Governance and funding strategies<sup>69</sup> are interdependent, with governance ensuring transparency and accountability, while funding strategies provide financial stability to implement policies, achieve objectives, and maintain stakeholder trust. Together, they create a balanced framework for sustainable decision-making, resource allocation, and long-term success in organisations.

Achieving a pilot fusion power plant requires sustained scientific, managerial, and financial commitments beyond the capacity of any single country. This necessitates close coordination of fusion efforts at the European level to address the technical challenges of mastering fusion and the extensive infrastructure required for its development.

Meanwhile, China and the U.S. are advancing rapidly, supported by significant funding from investors in startups and/or national programmes. As of mid-2024, private investment in fusion, primarily U.S.-based, surpassed \$7.1 billion<sup>70</sup>. China recently launched a national consortium<sup>71</sup> to build a fusion reactor by 2035, raising concerns about alignment with ITER and cooperation with the EU.

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<sup>69</sup> e.g., [https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:L\\_202401735](https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:L_202401735)

<sup>70</sup> <https://www.fusionindustryassociation.org/>

<sup>71</sup> <https://www.ans.org/news/article-5668/china-launches-fusion-consortium-to-build-artificial-sun/#:~:text=The%20Chinese%20government%20has%20set,Benefits%20of%20centralization%3F>

### FEG recommendations:

- **Increase Funding for Fusion Initiatives:** Assess the effectiveness of the EU support initiatives, such as the Clean Industrial Deal<sup>72</sup> and the adopted Affordable Energy Action Plan<sup>73</sup>, and address the financial needs of upcoming fusion public-private partnership (PPP) and Innovation initiatives for fusion. Additionally, strong national funding support for education, training, and research organisations is essential, particularly in countries with limited fusion-related R&D. Dedicated national funding will foster broader participation, enhance innovation across Europe, and accelerate progress towards fusion commercialisation.
- **Adopt a Multi-Phase Investment Approach:** Expand funding opportunities to include private equity, loans, and support from organisations like the European Investment Bank (EIB<sup>74</sup>) able to offer adequate financial scheme-ups. To promote EU fusion innovations, support SMEs, startups, and spin-offs through grants, procurement procedures, and incentive programmes such as prize-based funding.
- **Foster Collaboration and Accelerate Commercialisation:** Drive collaboration between industry, research organisations, and F4E through partnerships and the Important Project of Common European Interest (IPCEI<sup>75</sup>) on nuclear, which could include a fusion energy part<sup>76</sup>. This will accelerate the development of fusion energy technologies, strengthen Europe's technological leadership, and deliver significant economic benefits while advancing the path towards fusion commercialisation.

## 7. Conclusion

The recommendations in this FEG Opinion paper outline a clear path for making fusion a cornerstone of Europe's future energy landscape. Urgently, a comprehensive *EU Fusion Strategy* must be developed to create the right conditions and framework for overcoming technological barriers to the commercial deployment of fusion energy.

Supporting this strategy — a key objective of the FEG — will help align policies, resources, and efforts, unlocking fusion's transformative potential and securing a sustainable, competitive, and prosperous future for generations to come. With world-class scientific expertise and an ambitious vision, Europe is well-positioned to lead the global transition to fusion energy.

However, decisive action is required **now** to turn this vision into reality and establish Europe as a strong, independent leader in the field. Achieving this goal requires a strong, coordinated commitment from the European Commission, Member States, industry, academia, and all stakeholders. It also demands substantial investment — both public and private — along with seamless collaboration across Europe's innovation ecosystem.

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<sup>72</sup> [https://commission.europa.eu/topics/eu-competitiveness/clean-industrial-deal\\_en](https://commission.europa.eu/topics/eu-competitiveness/clean-industrial-deal_en)

<sup>73</sup> [https://energy.ec.europa.eu/publications/action-plan-affordable-energy-unlocking-true-value-our-energy-union-secure-affordable-efficient-and\\_en](https://energy.ec.europa.eu/publications/action-plan-affordable-energy-unlocking-true-value-our-energy-union-secure-affordable-efficient-and_en)

<sup>74</sup> <https://www.eib.org/en/index>

<sup>75</sup> [https://competition-policy.ec.europa.eu/state-aid/ipcei\\_en](https://competition-policy.ec.europa.eu/state-aid/ipcei_en)

<sup>76</sup> The pre-assessment fiche on "Nuclear Fusion Energy Technologies" is in progress (under the lead of Italy)

## GETTING IN TOUCH WITH THE EU

### In person

All over the European Union there are hundreds of Europe Direct centres. You can find the address of the centre nearest you online ([european-union.europa.eu/contact-eu/meet-us\\_en](https://european-union.europa.eu/contact-eu/meet-us_en)).

### On the phone or in writing

Europe Direct is a service that answers your questions about the European Union. You can contact this service:

- by freephone: 00 800 6 7 8 9 10 11 (certain operators may charge for these calls),
- at the following standard number: +32 22999696,
- via the following form: [european-union.europa.eu/contact-eu/write-us\\_en](https://european-union.europa.eu/contact-eu/write-us_en).

## FINDING INFORMATION ABOUT THE EU

### Online

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### EU publications

You can view or order EU publications at [op.europa.eu/en/publications](https://op.europa.eu/en/publications). Multiple copies of free publications can be obtained by contacting Europe Direct or your local documentation centre ([european-union.europa.eu/contact-eu/meet-us\\_en](https://european-union.europa.eu/contact-eu/meet-us_en)).

### EU law and related documents

For access to legal information from the EU, including all EU law since 1951 in all the official language versions, go to EUR-Lex ([eur-lex.europa.eu](https://eur-lex.europa.eu)).

### EU open data

The portal [data.europa.eu](https://data.europa.eu) provides access to open datasets from the EU institutions, bodies and agencies. These can be downloaded and reused for free, for both commercial and non-commercial purposes. The portal also provides access to a wealth of datasets from European countries.

The Fusion Expert Group (FEG) supports the development of an *EU Fusion Strategy*, expected to be published in view of the proposal of the Euratom Research & Training Programme for 2028–2032. This FEG Opinion Paper envisions fusion as a sustainable energy source and provides recommendations to accelerate its commercialisation. It identifies five key pillars that leverage research and ITER outcomes, foster a competitive industrial ecosystem, develop a skilled workforce, and drive innovation. The report emphasises the need for regulatory harmonisation, international collaboration, and an effective EU-level decision-making process in order to position fusion as a cornerstone of Europe’s energy future.

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