FUSION
INDUSTRY ASSOCIATION

The Global Fusion Industry

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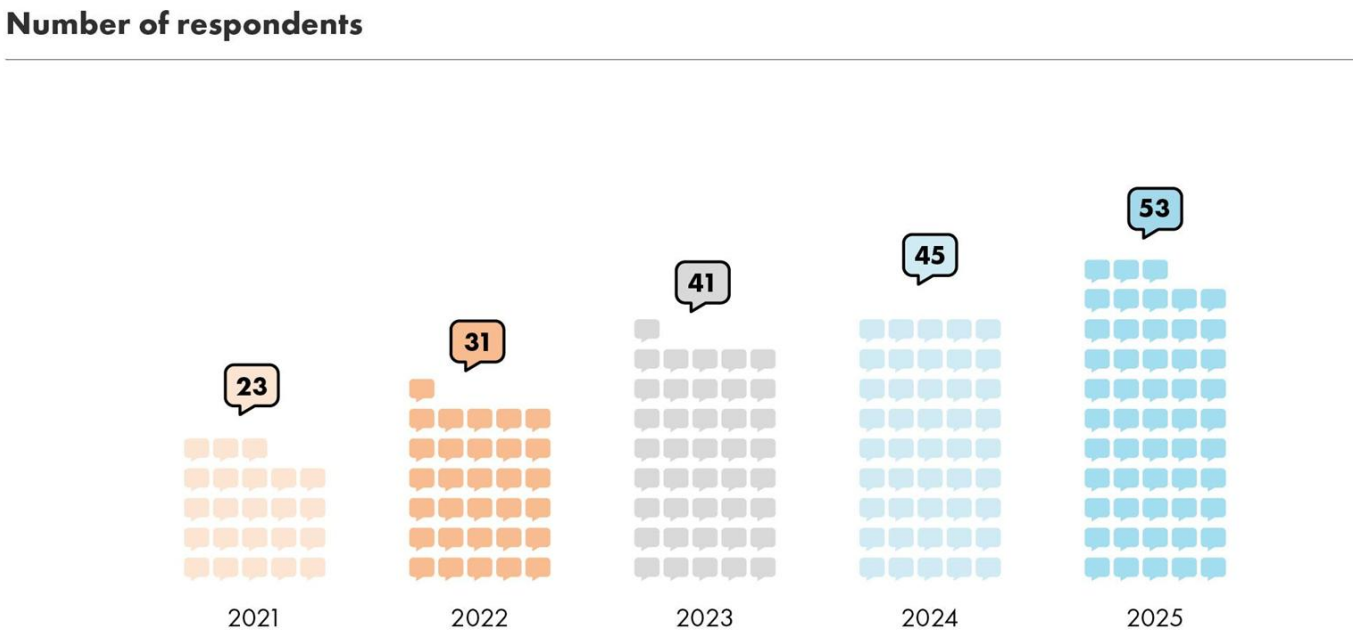
Overview

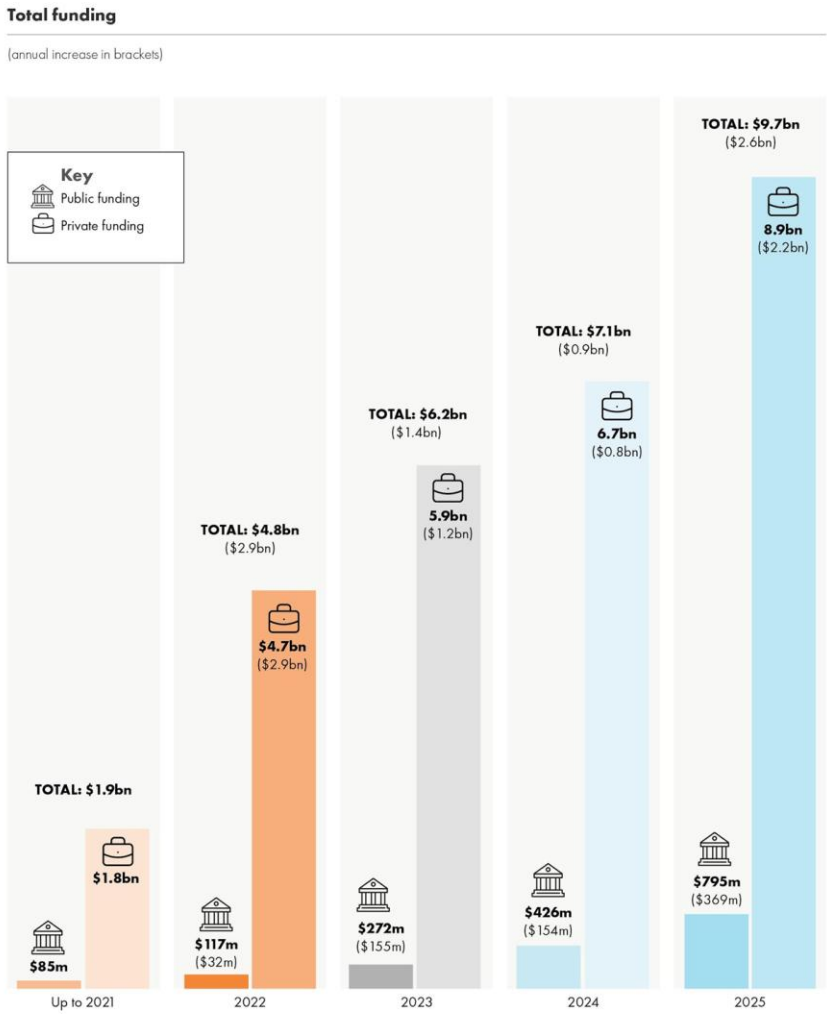
- **53** verified private fusion companies of diverse technologies
- **$9.76 billion** in investment
  - **$2.6 billion** raised in the last year
- **84%** increase in government funding to private companies
- 4,000 **new jobs** in or supported by the fusion industry
- Many billions more is needed

The global race to fusion has begun

Five Year Trends

- 5x increase in funding
- 30 more companies

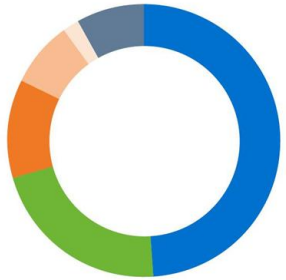




Geographic Distribution

- 29 American Fusion Companies
  - With > 80% of the investment
- Emerging “Hubs” of Ambition
- Global supply chain, workforce, and scientific collaboration

Technological Diversity



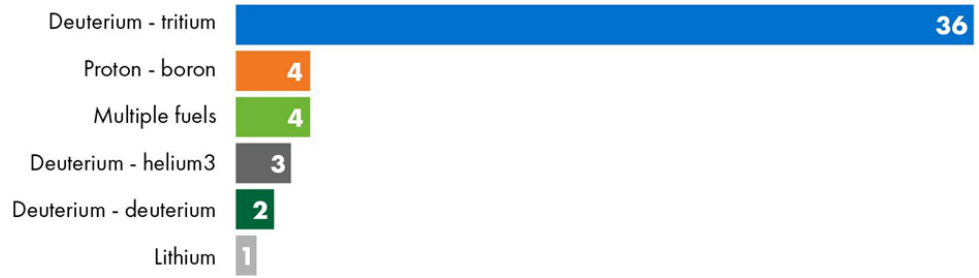
General approach

- **25** Magnetic confinement (inc. Tokamak, Stellarator)
- **11** Inertial confinement
- **6** Magneto-inertial
- **4** Hybrid electrostatic confinement
- **1** Muon-catalyzed fusion
- **4** Non-traditional concepts/Not stated

Specific approach

- **7** Stellarator
- **7** Laser-driven inertial confinement
- **4** Spherical tokamak
- **3** Tokamak
- **3** Magnetized target fusion
- **3** Magnetic-electrostatic confinement
- **3** Field Reversed Configuration
- **2** Laser-driven inertial confinement, with pB11 fuel
- **2** Z-pinch
- **1** Active-target muon production and high density fusion cell
- **1** Inertial-electrostatic lattice confinement
- **1** Poloidal magnetic confinement
- **1** Pulsed magneto-plasma pressurized confinement
- **1** Shock-driven inertial confinement
- **1** Plectoneme
- **1** Supporting Multiple Approaches
- **1** Dense Plasma Focus
- **1** Magnetic Mirror
- **1** Dynamic Stellarator
- **1** Levitated Dipole
- **1** Pulser-driven inertial confinement
- **1** Quasi-isodynamic stellarator
- **1** Spindle cusp, superconducting shielded-grid Inertial Electrostatic Confinement
- **1** Magnetic Mirror
- **1** Electrostatic confinement
- **1** Centrifugal Magnetic Mirror

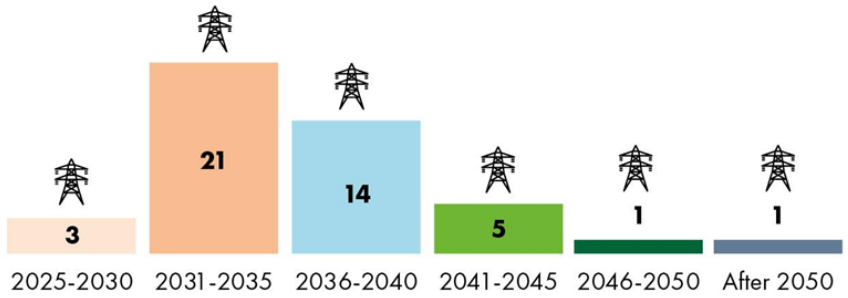
7. Fuel Source



Timelines

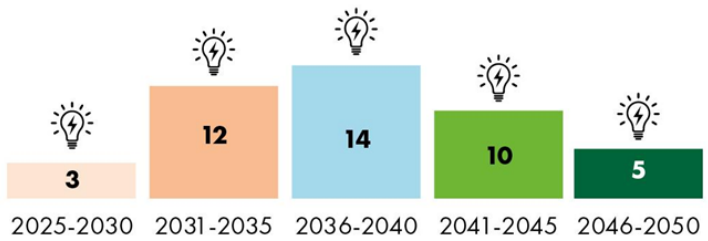
When will the first fusion plant deliver electricity to the grid?

(45 responses)



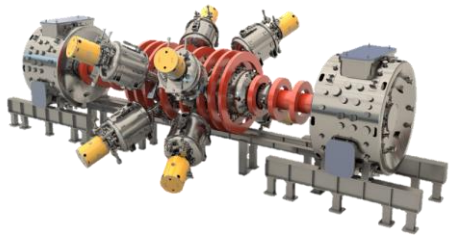
When will the first fusion plant demonstrate a low enough cost/high enough efficiency (Q) to be considered commercially viable?

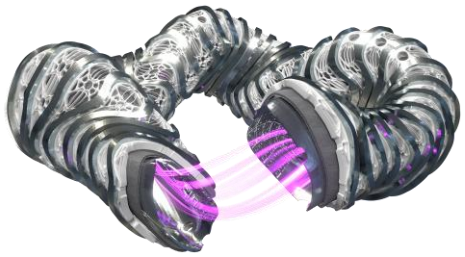
(44 responses)

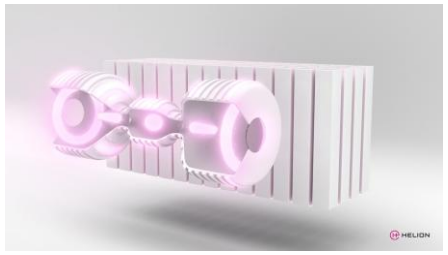


Industry's Timeline

60 years of research	Mid 2020s	Late 2020s	Early 2030s	Mid 2030s
• Scientific basis for fusion energy	• Scientific Proof of Concept	• Design and build Pilot Plants	• Operate Pilot Plants, first sales	• Commercial Fusion, rapid scale-up to global deployment



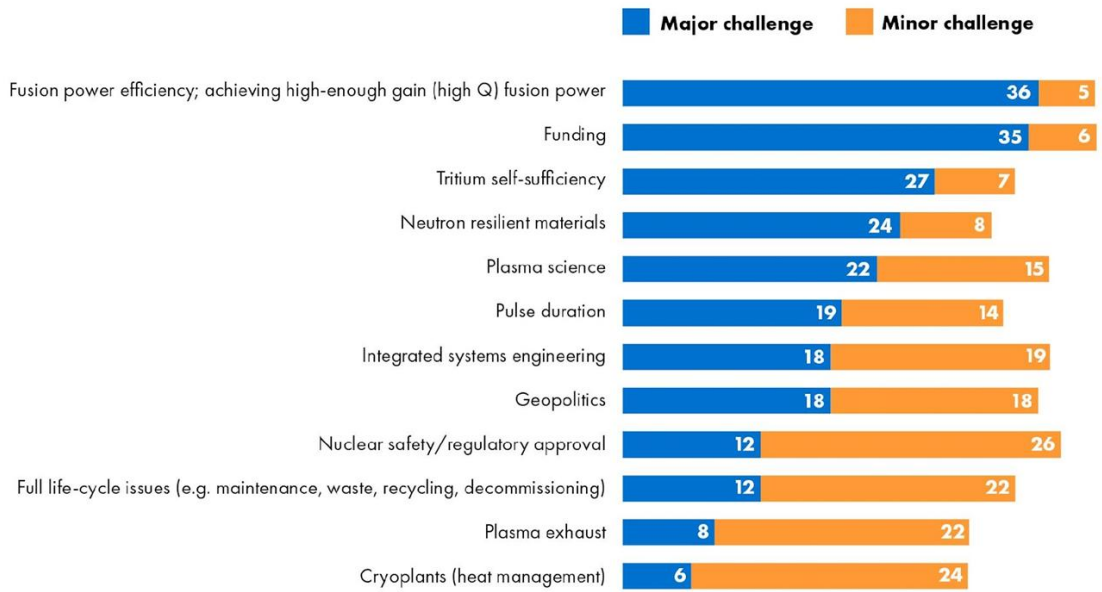




Fusion is Hard

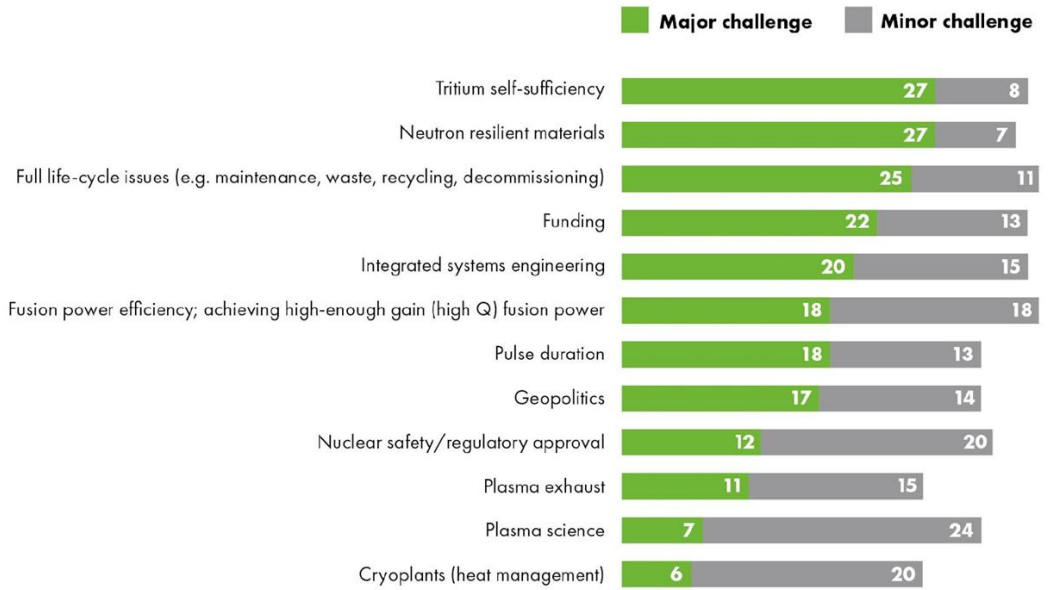
What do you see as the main challenges for fusion energy up to 2030?

(42 responses, non-reported answers indicate not seen as a problem/don't know)

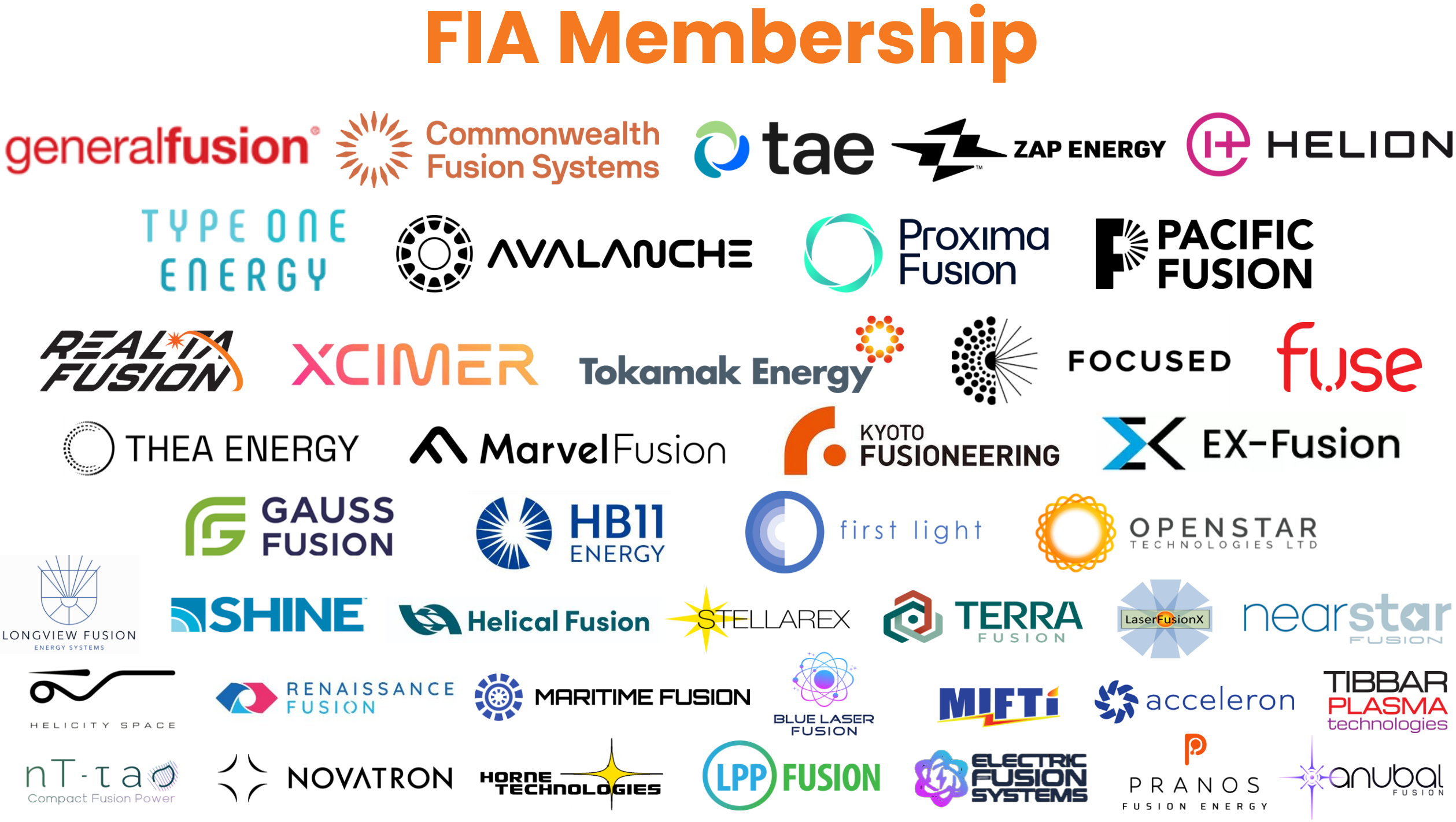


What do you see as the main challenges for fusion energy after 2030?

(38 responses, non-reported answers indicate not seen as a problem/don't know)



FIA Membership



FIA's Principles for Accelerating Fusion

Public-Private Partnership

The private sector should have access to the scientific research that governments have pursued for decades. While government programs transition from pure science to supporting commercialization, Public-Private Partnerships that include government support to private fusion companies can rapidly accelerate fusion development by driving new private investment

Ensuring Regulatory Certainty

The regulatory regime for fusion should be predictable, proportional to the risk, and supportive of innovation, while also giving confidence about ensuring public safety and security. Fusion energy regulation must be permanently separated from fission regulation and should not require lengthy permitting process for every facility.

Communicating Fusion's Benefits

Stakeholders should understand the promise of fusion energy, that it is coming on an accelerated timeline, and actively support its deployment. A knowledgeable public should support fusion deployment at scale.

NRC Decision

April 13, 2023: Commission unanimously approved fusion regulation under the Part 30 Byproduct Material framework

"[The framework] . . . can accommodate foreseeable fusion technologies in time for likely application submittals . . . [and] also provide[s] jurisdictional certainty for the Agreement States to regulate near-term fusion energy systems." – **Chair Hanson**

Commissioners favored Agreement State involvement

"It is notable that Agreement States are largely supportive of a byproduct material framework." – **Commissioner Crowell**

"This approach [i.e. Byproduct Framework] approach would also include the licensing and regulation of these systems by Agreement States where appropriate as has been the recent history." – Commissioner Caputo

Commissioners directed new Guidance to ensure Agreement States are supported

"[T]he staff should take into account the existence of fusion systems that already have been licensed and are being regulated by the Agreement States, as well as those that may be licensed prior to the completion of the rulemaking."

Next Steps

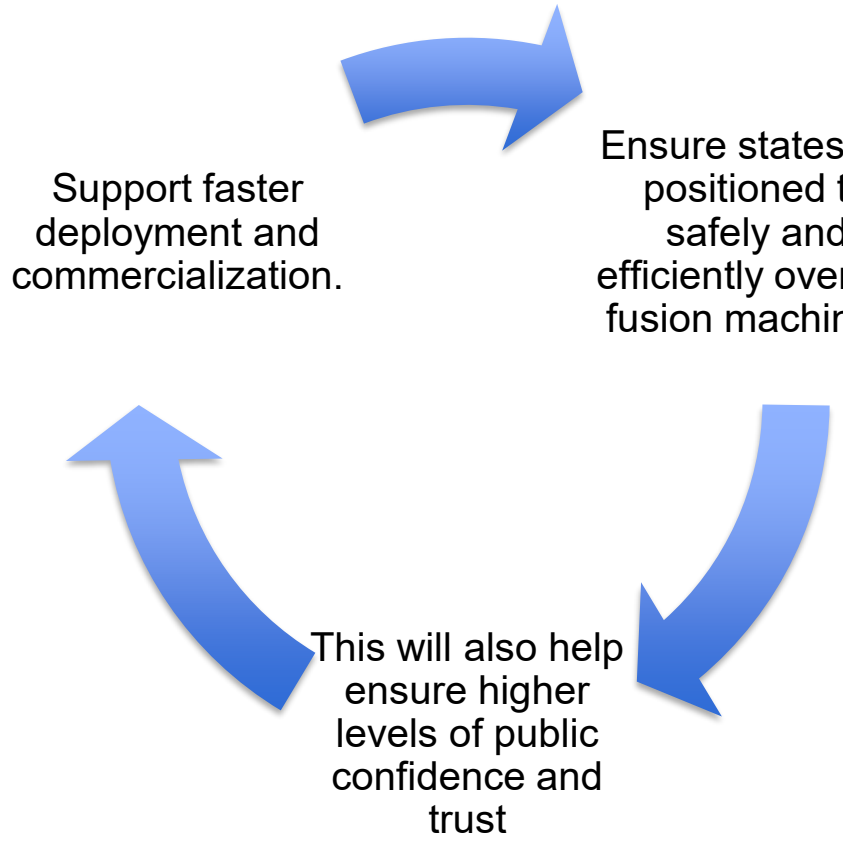
- Fusion Energy Act – passed in 2024 as part of ADVANCE Act
  - Amends Atomic Energy Act to solidify fusion regulation under Byproduct Material framework
  - Creates explicit definition for “fusion machine” that will be adopted by the NRC
- NRC Rulemaking
  - Proposed Rule sent to Commission on October 17, 2024 (not yet publicly released)
  - Set to be published ***SOON***
  - Final Rule anticipated 2026
- NRC developing new guidance – NUREG-1556, Volume 22
  - Supports Agreement State regulation by providing guidance for licensing and regulating fusion machines
  - Draft also sent to Commission on Oct. 17, but not yet available

Pathway for Agreement States to be Ready for Fusion

1. Decision to retain regulatory authority
2. Asses and examine whether and how to update state regulation
3. Ensure reciprocity for fusion machine licensing and design reviews
4. Manage Low-Level Radioactive Waste from fusion machines

OVERALL: Build Regulatory Capacity in Agreement States

Building Regulatory Capacity in Agreement States

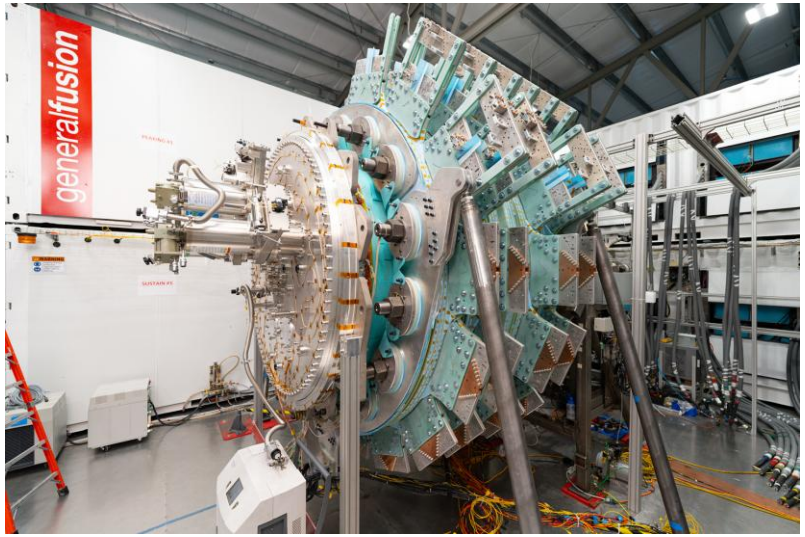


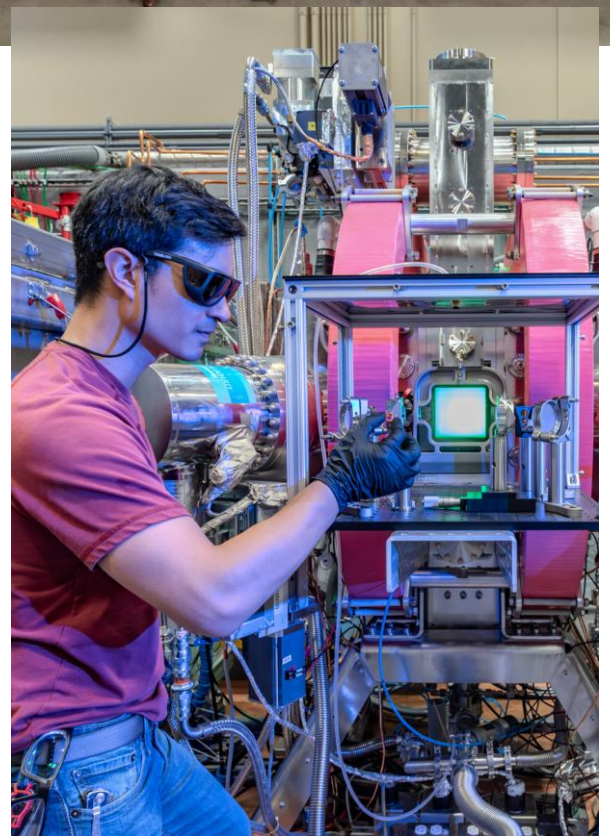
- FIA ready to support increased technical capacity of staff in agreement state regulators
- Enhancing capacity may involve investments in specialized training for regulators, recruiting subject-matter experts, and expanding state regulatory agencies to handle increased workload.

International Action

- USNRC/OAS efforts can serve as a model for international adoption
- USNRC working with UK Atomic Energy Agency and Canadian Nuclear Safety Commission on similar approach to regulating fusion machines
- Japan, Korea, Germany and other countries are leaning toward a similar “Byproduct Model” for fusion regulation
- FIA engaged through IAEA advocate for similar approach
- Common international approach for regulating fusion using US /UK/Canadian framework could supercharge potential adoption of commercial fusion machines

Progress





Thank You

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www.FusionIndustryAssociation.org