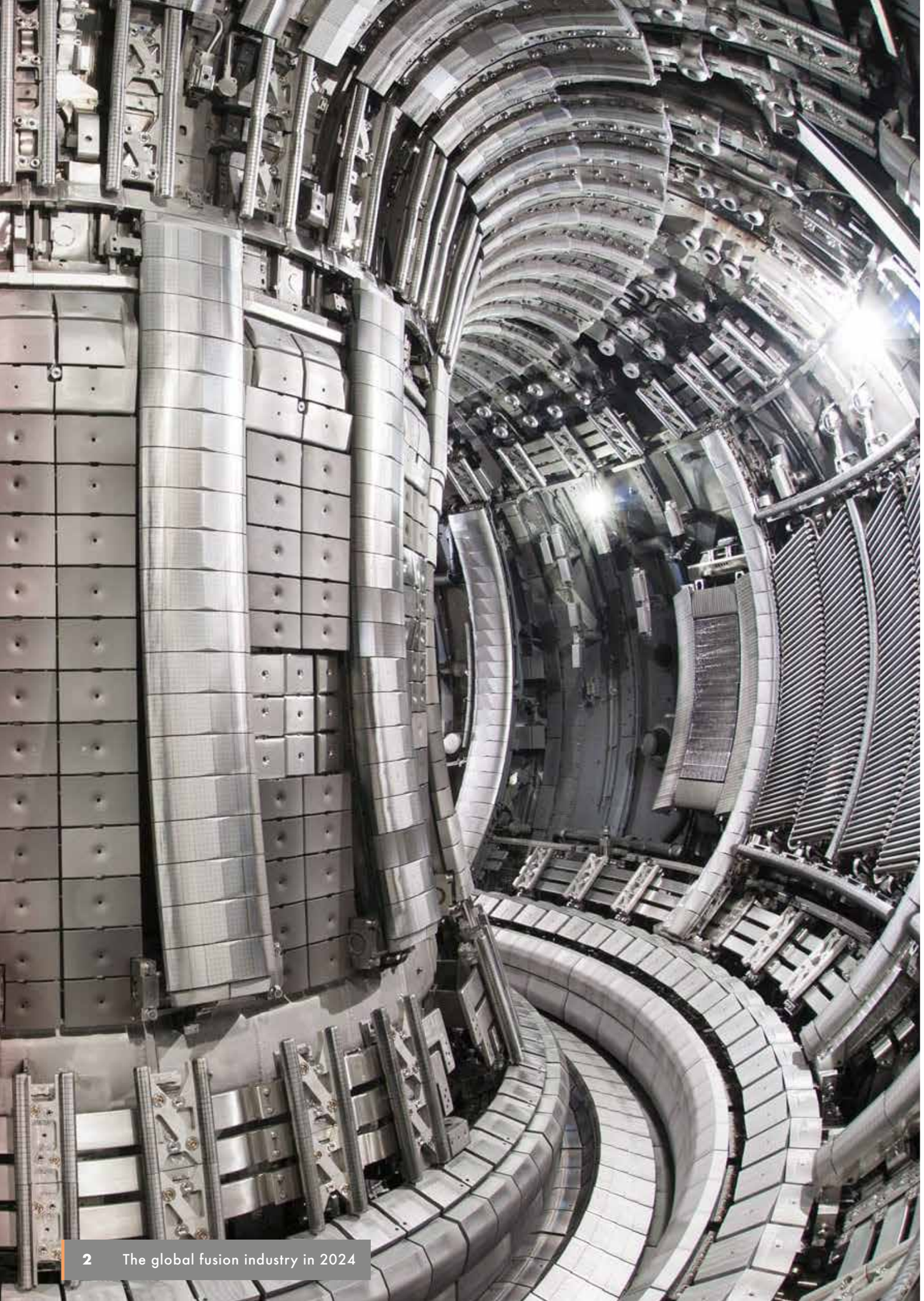
FUSION
INDUSTRY ASSOCIATION

The global fusion industry in 2024

Fusion Companies Survey by the Fusion Industry Association



FOREWORD

Now in our fourth edition, the FIA's yearly 'Global Fusion Industry in...' reports have become the global standard for understanding what is happening in the fusion energy industry. In this year's report, we once again see that the industry continues to grow, that investors remain supportive and enthusiastic about its potential, and that companies' ambitions for near-term commercialization are on track.

Although 'more of the same' may not sound headline-grabbing, it is exactly what we should see in a maturing industry. However, it's not all business-as-usual. Much needed change is also happening. This year saw significant shifts in government policies around the world, directing more public funding into private fusion companies. What's more, for the first time, this year's report highlights the growth of a skilled fusion workforce supporting this industry.

However, ambitious targets need ambitious resources and a step change in growth will be required once private companies deliver results on their prototype machines.

45 companies, very diverse technological approaches, and over $7 billion in funding

There are at least 45 companies working to commercialize fusion energy around the world. For the purposes of this report, two answered questions while in stealth mode and their identities are not revealed here, though they will go public at the appropriate time. One company withdrew its efforts to commercialize its own fusion power plant, while remaining active in the fusion industry as a key partner and supplier to fusion companies and experiments.

The total investment into fusion continues to grow. Over the last year, investors have put an additional billion dollars into the companies working to commercialize this groundbreaking technology. The total funding is now approximately $7.1 billion. Even in the face of continued challenges in raising capital for deep technology ventures, the additional funding underscores a growing confidence in fusion technology's potential to revolutionize the global energy landscape on a timescale that is relevant to investors.

Commercializing Fusion is increasingly a public-private partnership, with public funding into companies increasing by over 50%

Perhaps the biggest untold story shown in this report is the increase in public funding directed into private companies. The reported total (likely an undercount as some things inevitably go unreported), either from direct grants or cost-shares in public-private partnerships, has risen from $271 million in 2023 to $426 million in 2024. This increase in government investment not only reflects a heightened interest from national governments, but also signals a strategic choice by a growing number of governments that it will be business, not government, that will deliver the pilot plants that demonstrate fusion as a viable energy source.

Interior of JET Tokamak with superimposed plasma. Credit Eurofusion

Notable public-private partnerships that have moved forward in the last year include: the Milestone-Based Fusion Development Program in the United States, that in June 2024 announced eight companies had signed contracts with the Department of Energy to deliver comprehensive pilot plant designs; the German government's new "Fusion 2040" program that will invest directly into private companies; the Japanese government's "Moonshot" program; the British Government's ambitious new "Fusion Futures" program that invests in the key technology providers; and the European Union's recent effort to create a consortium that will define how it will invest in private fusion by 2026. Even ITER, the International Organization building the world's largest fusion experiment, has announced its interest in public private partnerships and its intention to directly share knowledge with private fusion companies.

The Fusion Industry Association, since its inception, has worked to secure new public private partnership programs because developers should have access to the knowledge and expertise developed in the public programs. Too often, there is a narrative of a competition or "race" between private companies and public programs to see which will get there first. These new and growing public-private partnerships indicate that narrative is wrong: fusion will be commercialized by private companies, while the public programs continue to lead the world with pathbreaking scientific research and enabling technology. Competition is good among companies for spurring private sector innovation, but there is no need to pit government programs against private companies. The two must support each other. As fusion advances towards commercialization, the consistent and growing investment from both private and public sectors is vital for overcoming the scientific and engineering challenges that remain.

Ambitious timelines need ambitious resources

Anyone working in fusion knows the question we get the most (and have for decades!) is the question of timing. We have seen the headlines about fusion in the newspapers from the 1960s and '70s saying that fusion was just around the corner. Even governments were optimistic, with plans put into place to build power plants. Knowing that those predictions did not come to pass, fusion scientists and energy stakeholders have a right to be cautious about bold timelines. Those delayed timelines can be blamed on two important causes: fusion is hard, but even more importantly, the promised funding for the next steps never emerged. A bold plan without bold resources is bound to fail.

The rise of a private fusion industry in the last decade provides an antidote to the pessimism of decades past. By applying new technology, advanced materials, increased computing power, and private sector ambition, investor-backed companies have shown that there is a path to fusion power on a timeline that is relevant to the world's energy challenges.

In the fourth year of this report, companies remain steadfast in their projected timelines for producing fusion-generated electricity in the 2030s, with most companies aiming for fusion electricity generation in the first half of that decade. 89% of the companies responding to the survey anticipate that fusion will provide electricity to the grid by the end of 2030s, with 70% of the companies saying that milestone will happen by the end of 2035. Since this report was first released in 2021, these questions have received similar answers. We have not seen timelines slip. The industry is hitting its own milestones, and remains on track.

Skilled Fusion Workforce Grows by 1,000 people year over year

Finally, the fusion energy sector has seen a consistent increase in employment, reflecting its expanding footprint and economic significance. For four consecutive years, the number of jobs within the industry has risen, with total employment figures growing from 1,096 in 2021 to over 4,107 in 2024. Many more people are employed in the companies that supply fusion. This steady rise in job creation highlights the industry's growth and its capacity to attract and retain a diverse and skilled workforce.

The workforce within the fusion industry is composed predominantly of scientists and engineers, who together constitute approximately 73% of all employees. This high concentration of technical expertise is indicative of the intensive research and development efforts required to advance fusion technology. Furthermore, the sector's ability to consistently increase employment underscores its resilience and adaptability in a rapidly evolving technological landscape. Workforce needs will continue to grow, and the industry has adopted an "all hands on deck" approach to hiring skilled employees from diverse backgrounds and outside the traditional scientific sectors.

Conclusion: A growing industry, but a step change in growth is needed

This report shows continued growth in the fusion industry, across multiple indicators. However, positive though it is, it is not enough yet to deliver fusion's ambitious goals. If funding into private fusion companies only grows at $1 billion per year over the next decade, the industry will not meet its bold targets. If the workforce only grows at a rate of 1,000 people per year, there won't be enough people to build the pilot plants.

Fortunately, multiple companies are building or experimenting with prototype and proof of concept machines right now. As soon as these deliver results, they will de-risk investment. That will unlock a vast pool of lower-risk capital that will bring the needed leap in funding. As fusion companies continue to innovate and develop, supported by both public and private investments, the vision of a sustainable and abundant energy future powered by fusion is increasingly attainable.

Andrew Holland
Chief Executive Officer
Fusion Industry Association

HIGHLIGHTS TO DATE

1. Total funding*

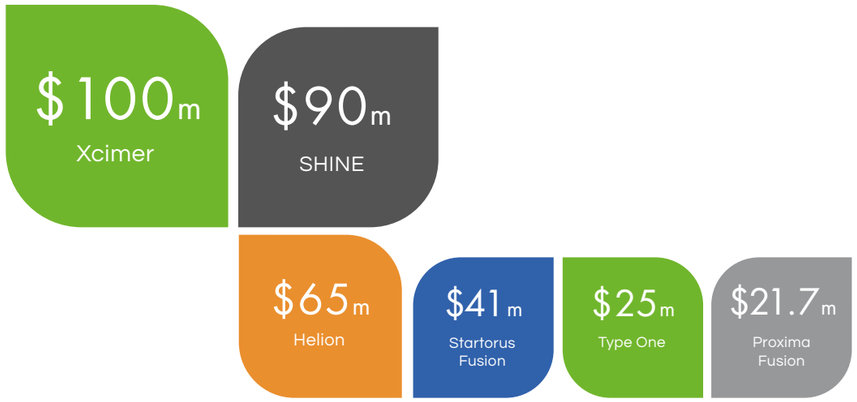
Total this year	**>$900,000,000 (900m)**
Total to date	**~$7,122,435,000 (7.1bn)**
Total Public	**~$426,000,000 (426m)**

2. Change since 2023 survey

$7.1bn in funding, compared to **$6.2bn** at time of 2023 survey
$426m in public funding, compared to **$271m** in 2023
45 responses in 2024 vs 43 2023
3 new companies emerged and added to our survey, while one withdrew from the commercial industry.

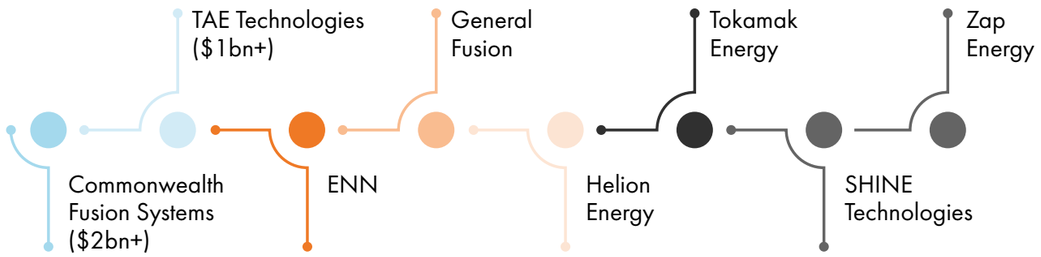
** Some figures have been converted to dollars/rounded*

3. Notable investments since 2023 survey*



** Several other large investments have not yet been publicly announced so are not included here*

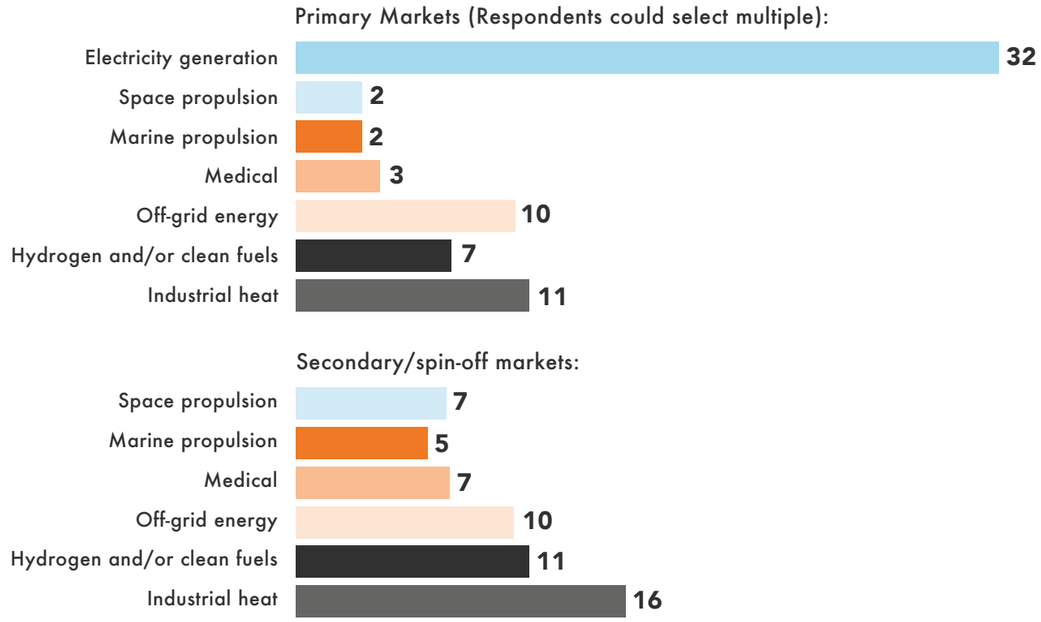
4. Companies with $200m investment or more



5. Location

By primary HQ

6. Target markets



Other named markets included: Mobility, Compact portable power, Imaging, LDRS, Tritium Production, HTS, Transmutation of nuclear waste, Defense

7. Employees

Employed by fusion companies*

2021 **1,096 (23 companies)**

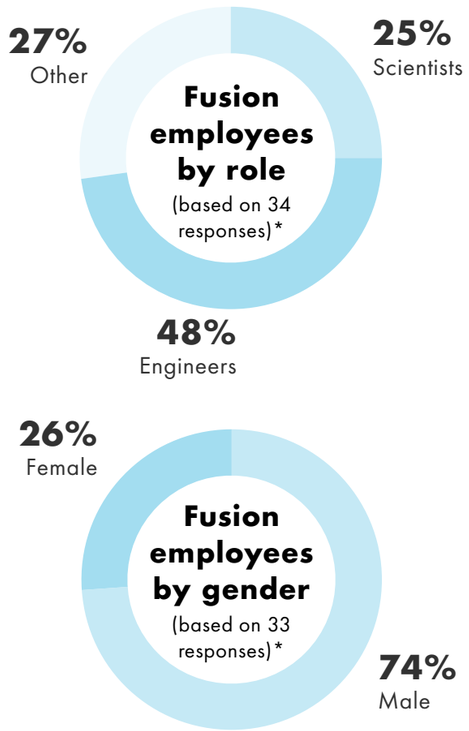
2022 **1,545 (31 companies)**

2023 **3,073 (41 companies)**

2024 4,107 (43 companies)

Estimated **~5,900** jobs supported by fusion companies' supply chain

**Self-reported*



These are rough estimates. Numbers are approximate and based on companies estimated figures, rounded to nearest 10%. Companies that did not provide demographic and role data are not reflected in these figures.

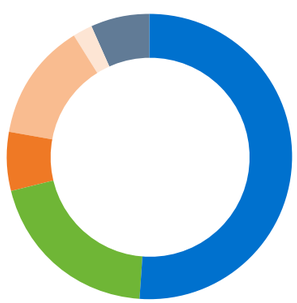
8. Selected* investors in fusion

11.2 Capital
31VENTURES
Addition
AE Blue Capital
Airbus Ventures
Alcen
Anglo American
ANRI
Art Samberg
Baillie Gifford
Bayern Kapital
Bezos Expeditions
Bill Gates
Blackbird Ventures
Braavos Capital
Braemar Energy Ventures
Breakthrough Energy Ventures
Bruker
Business Development Bank of Canada
Capricorn Investment Group
Cenovus Energy
Charles Schwab
Chevron Technology Ventures
Chrysalix Venture Capital
Climentum
Coatue
Congruent
Coral Capital
Darco Capital
David Harding
DBJ Capital Co., Ltd.
DCVC
Delight Ventures
DFJ Growth
Doral Energy
Dr Hans-Peter Wild
Dustin Moskovitz
EIT InnoEnergy
Electric Power Development Company
Emerson Collective
Energy Impact Partners
Eni
Enlightenment Capital
Equinor
EQT Foundation
Fidelity Management and Research Company
Fine Structure Ventures
Footprint Coalition
Founders Fund
Fujikura Ltd
Future Ventures
GA Capital
German Federal Agency For Disruptive Innovation
GIC
Gigascale Capital
Google
Granitor
Grantham Foundation
Hedosophia
Hitachi Ventures
Hofima
Hostplus
HTGF
Icehouse Ventures
InnoEnergy
Industrifonden
Inpex Corporation
IP Group
Itochu
J-POWER
JAFCO Group
Jameel Investment Management Company (JIMCO)
Jeff Bezos
JGC MIRAI Innovation Fund
JIC Venture Growth Investments
John Doerr
JS Capital
K1W1 Ventures
K4 Ventures
Kam Ghaffarian
KDDI
Khazanah Nasional
Khosla Ventures
KTH Holding
Kuwait Investment Authority
Kyoshin
Kyoto Capital Partners Co., Ltd.
Leave-a-nest
Lockheed Martin Ventures
Lowercarbon Capital
Maezawa Fund
Maryland Energy Innovation Accelerator
Max Planck Gesellschaft
Mercator Partners
miHoYo
MILFAM
Ministry of Jobs, Economic Development and Innovation, Government of British Columbia
Mitsubishi UFJ Capital
Mitsui Kinzoku
MOL PLUS
MSIVC
MUFG Capital
MUFJ Capital
New Zealand Growth Capital
Ngāi Tahu
Nikon
Nikon SBI
Nissay Capital
Nucor
Orion Industrial Ventures
Orbia Ventures
Osaka Shoko Shinyo Kinko
Outset Ventures
Plural Platform
Prelude Ventures
Radar Ventures
Redalpine
SBI Investment
SDGx
Segra Capital Management
SET Ventures
Shanghai STVC group
Shizuoka Capital
Shorewind Capital
SMBC Capital
SMBC Venture Capital
Softbank
Sony
Starlight Ventures
StartEngine
Strategic Innovation Fund, Government of Canada
Sumitomo
TDK Ventures
Temasek
The Rocket Equation Ventures
Toyota
Trirec
UVC Partners
Vahoca
Venture Growth Investments Co., Ltd.
Wilbe
Wireframe Ventures
Wisconsin Alumni Research Foundation (WARF)
YUNHE Partners

** All of these investors have been publicly identified in the current or previous surveys. The FIA is not responsible for the responses listed in this report from survey participants and do not intend to disclose any proprietary information.*

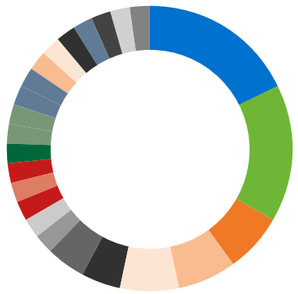
9. Public Private Partnerships

10. Approach



General approach

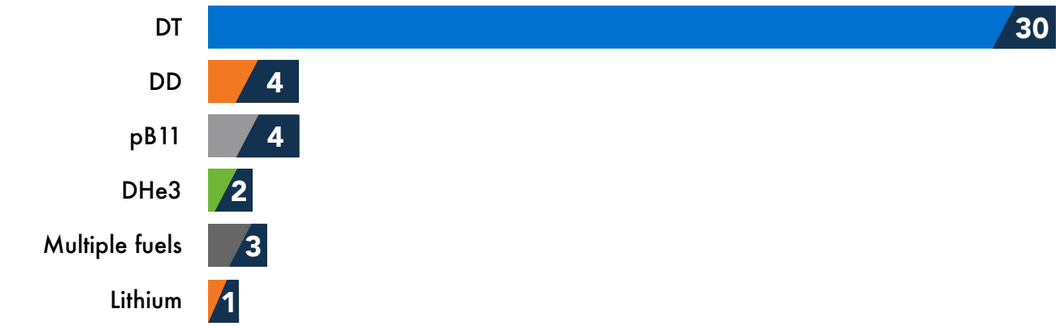
- **23** Magnetic confinement
- **9** Inertial confinement
- **3** Hybrid magnetic/electrostatic confinement
- **6** Magneto-intertial
- **1** Muon-catalyzed fusion
- **3** Non-traditional concepts/Not stated



Specific approach

- **8** Stellarator
- **7** Laser-driven inertial confinement
- **3** Tokamak
- **3** Spherical tokamak
- **3** Field Reversed Configuration
- **2** Z-pinch
- **2** Magnetized target fusion
- **1** Levitated Dipole
- **1** Magnetic mirror
- **1** Centrifugal Magnetic Mirror
- **1** Magnetic-electrostatic confinement
- **1** Magnetized Liner Inertial Fusion (MagLIF)
- **1** Muon-catalyzed fusion with high density fuel
- **1** Open magnetic confinement (Mirror machine)
- **1** Magnetic electrostatic
- **1** Plectoneme
- **1** Poloidal magnetic confinement
- **1** Pulsed magneto-plasma pressurized confinement
- **1** Shock-driven inertial confinement
- **1** Short-Pulse Laser-Driven Inertial Confinement
- **1** Spindle cusp
- **1** Dense Plasma Focus
- **1** Electro-centripetal confinement
- **1** Agnostic

11. Fuel Source



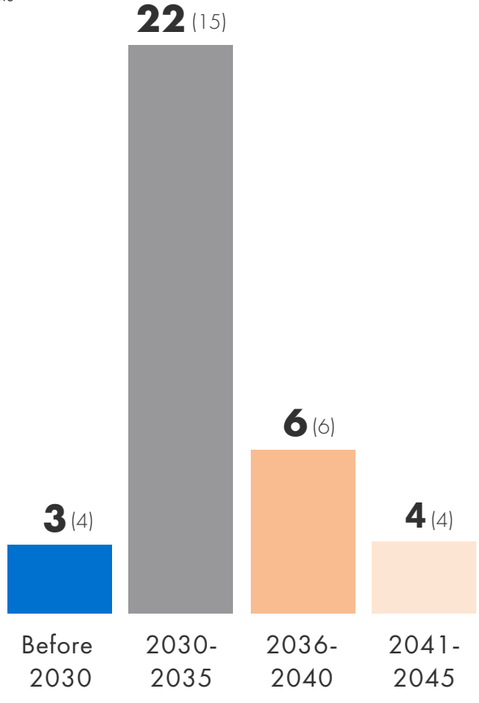
Fuel source Key

DT	deuterium - tritium
DD	deuterium - deuterium
pB11	proton - boron
DHe3	deuterium - helium3

12.

When do you anticipate your company will deliver power to the grid? (35 responses)

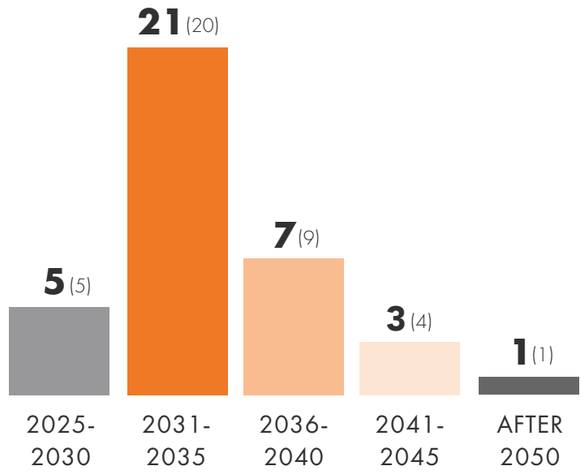
**Last year's response in brackets*



13. Predictions

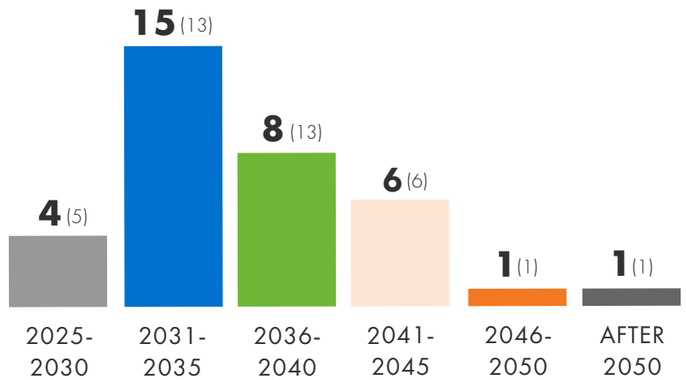
When will the first fusion plant deliver electricity to the grid? (37 responses)

**Last year's response in brackets*



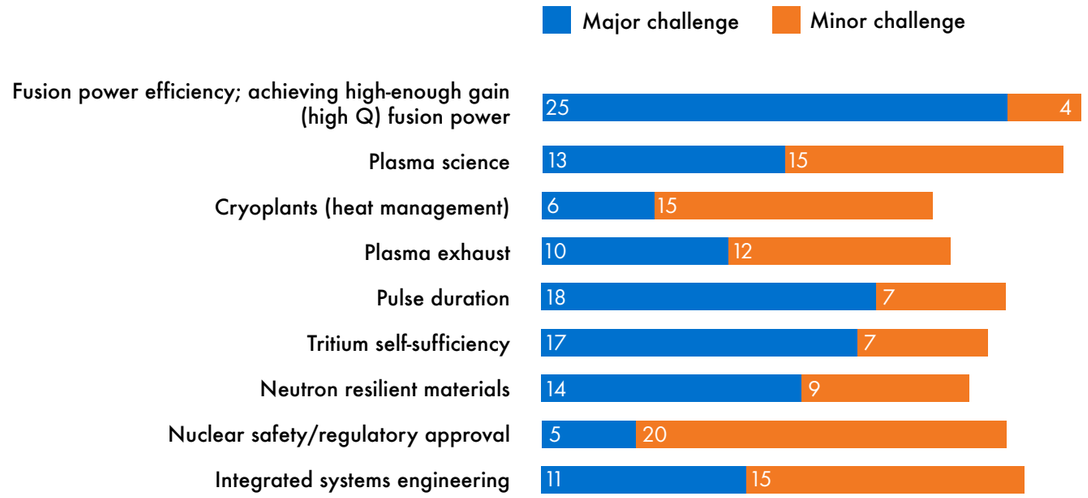
When will the first fusion plant demonstrate a low enough cost/high enough efficiency (Q) to be considered commercially viable? (35 responses)

**Last year's response in brackets*

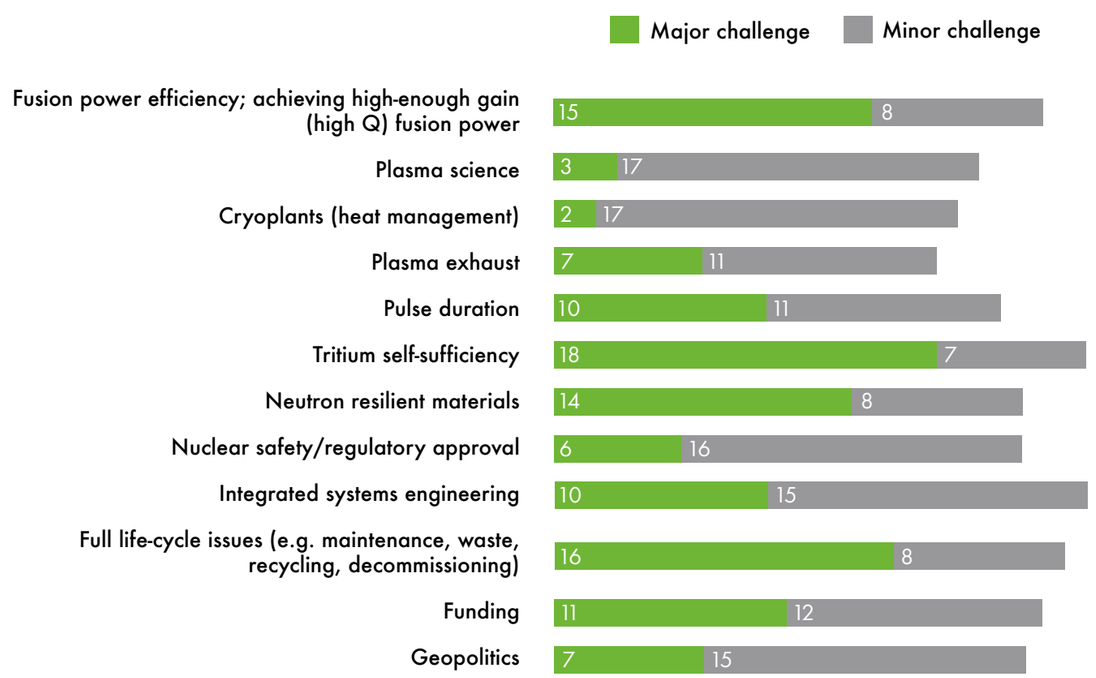


14. Challenges

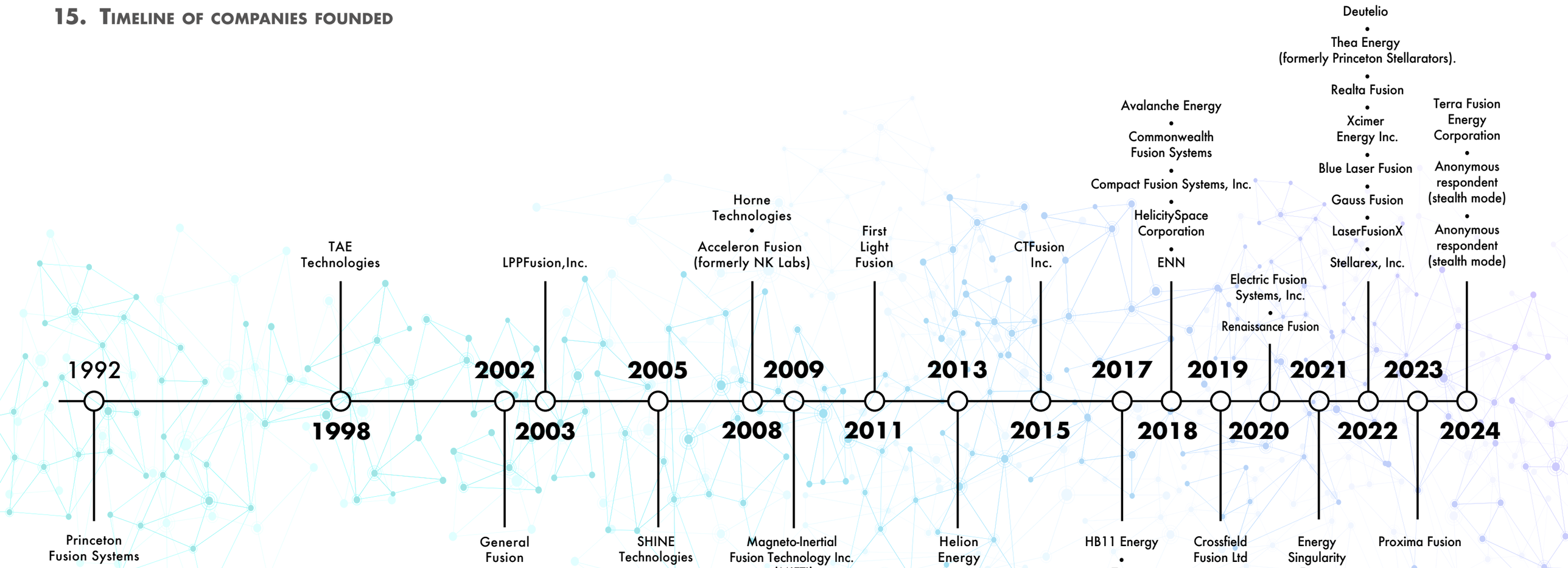
What do you see are the main challenges for fusion energy up to 2030?
(38 reponses, non-reported answers indicate not seen as a problem/don't know)



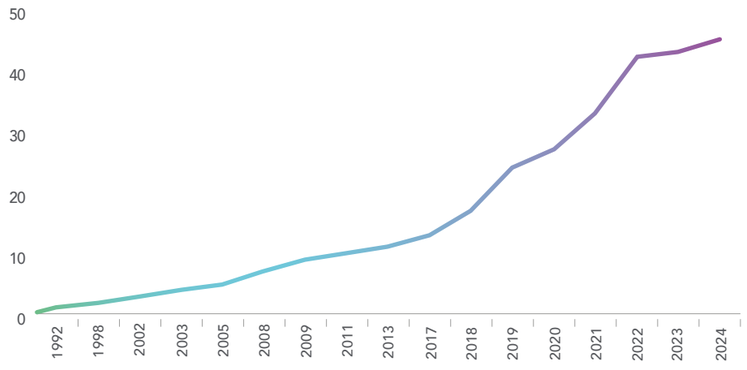
What do you see are the main challenges for fusion energy after 2030?
(36 reponses, non-reported answers indicate not seen as a problem in this timescale)



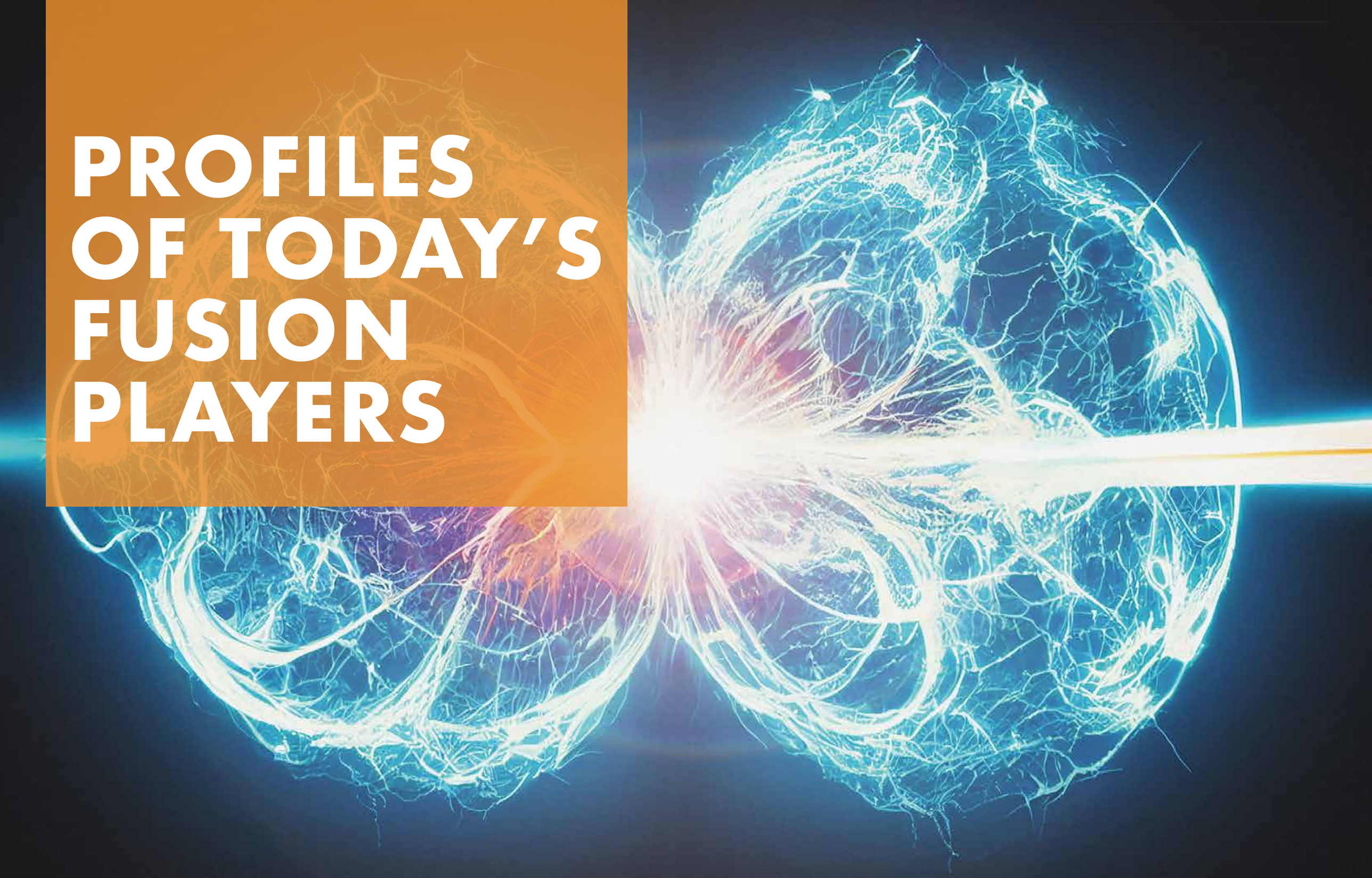
15. Timeline of companies founded



16. Total number of private fusion companies by year



PROFILES OF TODAY'S FUSION PLAYERS



FIA MEMBER

acceleron

ACCELERON FUSION

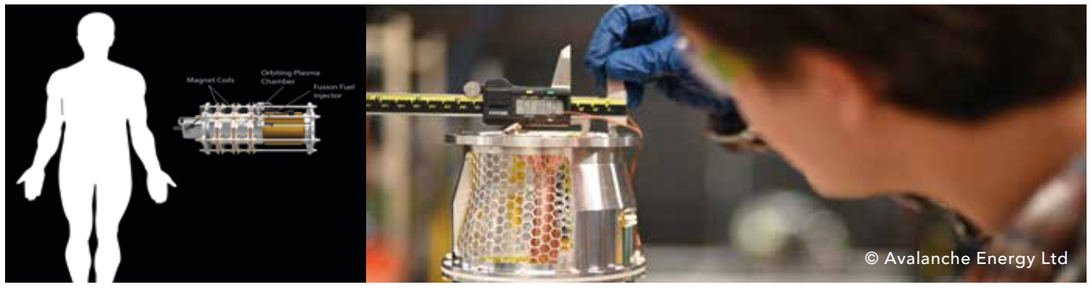
Acceleron Fusion (formerly NK Labs), Inc. is developing muon-catalyzed fusion as a new source of clean energy. Our approach builds on decades of work by government labs worldwide and leverages recent developments in advanced materials and computational optimization.

Location	Cambridge, Massachusetts, USA
Contact details	info@acceleron.energy
Year founded	2023
Founder names	Ara Knaian, Seth Newburg
Primary target markets	Electricity generation, Medical, Hydrogen and/or clean fuels, Industrial heat, Tritium Production
Total declared funding to date	$5,200,000
Employees (incl. full time consultants)	10
General approach	Muon-catalyzed fusion
Specific approach	Muon-catalyzed fusion with high density fuel
Fuel source	DT
Planned energy capture approach	Molten salt with heat exchanger
Pilot plant timescale	2032
Anticipated MWe of your commercial operating facility?	100MWe
Milestones in past 12 months	Target cell reached 1.5 GPa pressure at 500K Received license to use tritium
Key collaborators/partners	Fermilab, Paul Scherrer Institute, Oak Ridge National Lab, University of Rochester, Torion Plasma
Recent spin outs/patents/commercial innovations	US 20230386685, "Muon Catalyzed Fusion Reactor and System with Electromagnetic Muon Reactivation and Methods of Making and Use Therof"
Recent published papers	A.Knaian, "Diamond Anvil Measurement of Muon-Catalyzed Fusion Kinetics," Open CHRISP Users Meeting BVR55, Villigen Switzerland, February 2024 S. Tripathy, K.R. Lynch, A. Knaian, N. MacFadden, D. Harrington, "GEANT4 Simulation Package for Interactions Related to Muonic Atoms and Muon-Catalyzed Fusion (CF)," 41st International Conference on High Energy Physics – ICHEP2022 N. Macfadden, A. Knaian, "Efficient modelling of particle transport through aerosols in GEANT4," Computer Physics Communications, Volume 278, September 2022

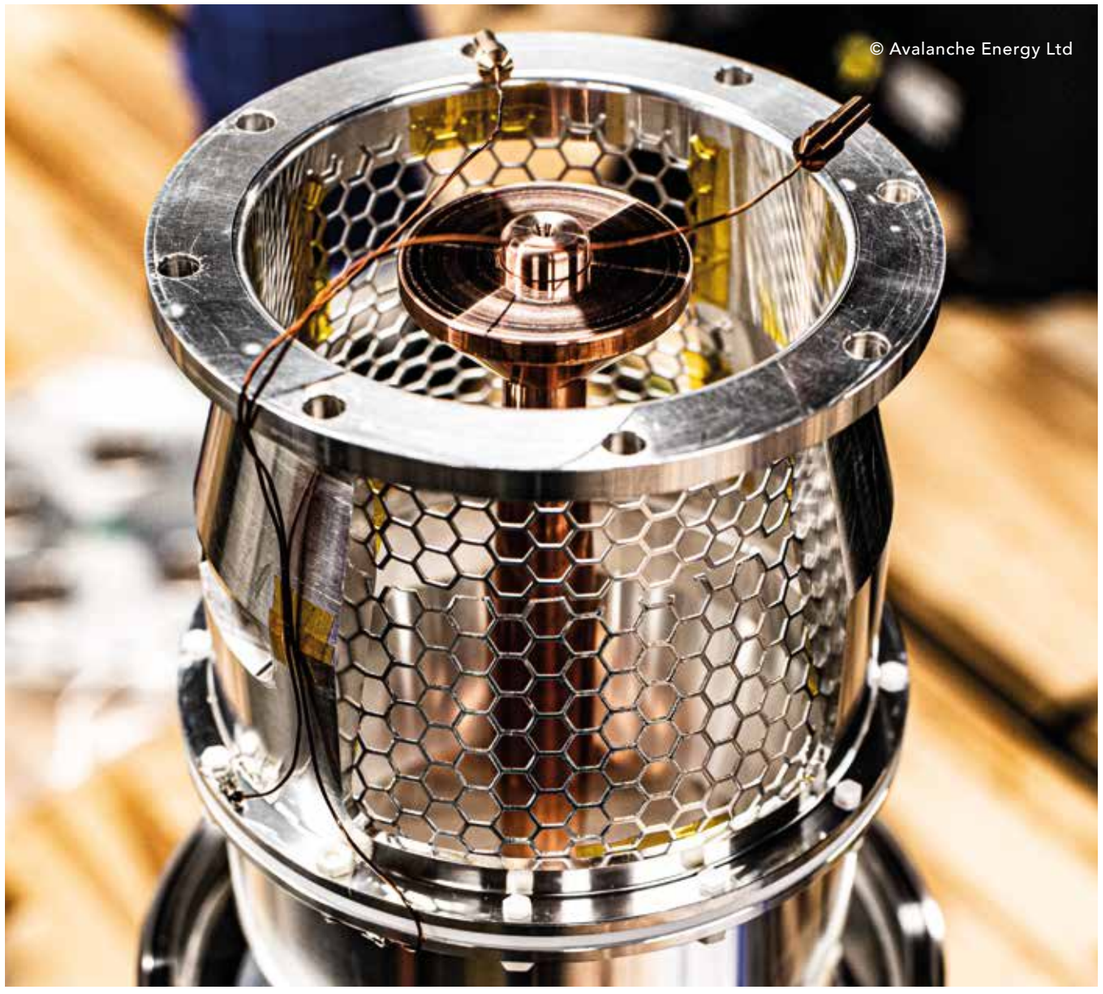
AVALANCHE ENERGY

Avalanche Energy is developing a modular 5kWe fusion microreactor, called the Orbitron, for hard-to-decarbonize applications. Its compact size and modularity are game changers for dual-use, mobile and distributed power applications across air, land, sea, and space. Some potential applications include islanded micro-grids in austere/remote environments, electric vehicle battery recharging, and spacecraft power and propulsion.

Location	Tukwila, Washington, USA
Contact details	reachout@avalanche.energy
Year founded	2018
Founder names	Robin Langtry, Brian Riordan
Primary target markets	Space propulsion, Marine propulsion
Total declared funding to date	$53,500,000
Employees (incl. full time consultants)	48
General approach	Hybrid electrostatic confinement
Specific approach	Magnetic-electrostatic confinement
Fuel source	DT
Planned energy capture approach	Lithium neutron 'blanket'
Pilot plant timescale	Q4/2025 delivery of first prototype to DIU/DoD for qualification testing. Orbital demonstration in 2028.
Anticipated MWe of your commercial operating facility?	0.005MWe
Milestones in past 12 months	- Developed diagnostics for novel magneto-electrostatic high energy, low-density plasmas. - Designed, fabricated and tested 3 fusion machines: NEO, MARTY, CAMINA and working on scaling up plasma density and fusion rates.
Key collaborators/partners	Defense Innovation Unit (DIU); DoD Navy; NSF



Recent spin outs/patents/commercial innovations	US Patent US11948697B2 "Orbital confinement fusion device" R. Langtry and B. Riordan.
Recent published papers	1) "Impact of Direct Current Conditioning on Cathode Dark Current in High Vacuum," 2023 30th International Symposium on Discharges and Electrical Insulation in Vacuum (ISDEIV), Okinawa, Japan, 2023, pp. 74-77 2) "The Aging Effect of Surface Flashovers on Insulator Surface in Vacuum: A Case Study," 2023 IEEE Conference on Electrical Insulation and Dielectric Phenomena (CEIDP), East Rutherford, NJ, USA, 2023, pp. 1-6 3) "Characterization of a broad beam ion source converted into a high intensity deuterium beam." In Journal of Physics: Conference Series, vol. 2743, no. 1, p. 012075. IOP Publishing, 2024



FIA MEMBER

BLUE LASER FUSION INC.

Blue Laser Fusion has developed a novel high-power laser technology for fusion, capable of achieving a high repetition rate and power to achieve clean energy generation. It plans to adopt an aneutronic reaction using a novel mixture of high gain solid fuel target materials for sustainable and environmentally friendly operations.

Location	Goleta, California, USA (HQ); Tokyo, Japan
Contact details	contact@bluelaserfusion.com
Year founded	2022
Founder names	Shuji Nakamura, Hiroaki Ohta, Richard Ogawa
Primary target markets	Electricity generation
Total declared funding to date	$37,500,000
Employees (incl. full time consultants)	15
General approach	Inertial confinement
Specific approach	Laser-driven inertial confinement
Fuel source	Combination
Planned energy capture approach	Direct energy conversion
Pilot plant timescale	2030
Anticipated MWe of commercial operating facility	500MWe
Interim plants or facilities planned	Blue Laser Fusion plans to demonstrate its high pulse rate laser and novel target fuels before commercialization.
Milestones in past 12 months	Demonstrated an early version of its laser and target fuels.
Recent company investments	Blue Laser Fusion GK in Japan; and Research and Development facilities in Goleta.
Key collaborators/partners	Softbank Corp.; Itochu
Recent spin outs/patents/commercial innovations	50+ patent rights.

Commonwealth Fusion Systems

FIA MEMBER

COMMONWEALTH FUSION SYSTEMS

Commonwealth Fusion Systems' (CFS) mission is to deploy fusion power plants to meet increased global energy demand and decarbonization goals as fast as possible. CFS leverages decades of research in tokamaks combined with new groundbreaking high-temperature superconducting (HTS) magnet technology. CFS is currently constructing SPARC, a Q~10 demonstration plant using actual fusion fuels based on peer-reviewed science.

Location	Devens, Massachusetts, USA
Contact details	info@cfs.energy
Year founded	2018
Founder names	Bob Mumgaard, Dan Brunner, Brandon Sorbom, Dennis Whyte, Martin Greenwald, Zach Hartwig
Primary target markets	Electricity generation
Total declared funding to date	~$2,000,000,000
Employees (incl. full time consultants)	1,000
General approach	Magnetic confinement
Specific approach	Tokamak
Fuel source	DT
Planned energy capture approach	Lithium neutron 'blanket'
Pilot plant timescale	2026: SPARC attains first plasma, with Q > 1 shortly after, producing more fusion energy (heat) than required to run the machine; Early 2030s: First fusion power plant, called ARC, is completed.
Anticipated MWe of first commercial operating facility	400MW
Interim plants or facilities planned	2025: complete construction of SPARC and subsystems. 2026: SPARC is operational - a machine that will demonstrate commercially relevant net energy from fusion, many fusion subsystems, and the delivery of a near full scale system.
Milestones in past 12 months	Construction ongoing for SPARC facility in Devens, MA.

Key collaborators/partners	Massachusetts Institute of Technology; Brookhaven National Lab; Columbia University; University of Michigan; Pacific Northwest National Laboratory; Lawrence Livermore National Lab; Max Planck Institute for Plasma Physics; Oak Ridge National Lab; Princeton Plasma Physics Lab; Robinson Research Institute; Sandia National Laboratory; Type One Energy; University of California at San Diego University of Maryland; University of Rochester; University of Texas at Austin; University of Torino; University of Wisconsin; University of York; Realta Fusion; Savannah River National Laboratory; EPFL; DIFFER; UKEA

CROSSFIELD FUSION LTD

Nuclear fusion start-up, prototyping novel methods for accelerating and manipulating fusion fuel ions for fusion-neutron and isotope production.

Location	London, UK
Contact details	enquires@crossfieldfusion.com
Year founded	2019
Founder names	James McKenzie, Chris Macdonald-Bradley
Primary target markets	Medical, Commercially relevant neutron source including isotope manufacture and fusion-energy-spectrum relevant materials testing
Total declared funding to date	$500,000
General approach	Closed Orbit, velocity resonant systems
Specific approach	Electro-centripetal confinement with magnetic plasmas not in thermodynamic equilibrium
Fuel source	DD
Planned energy capture approach	IP in progress, not currently for disclosure
Pilot plant timescale	Not currently planned
Anticipated MWe of your commercial operating facility?	Initial objective; ~10kW neutron flux (~Peta. neutron/s)

DEUTELIO

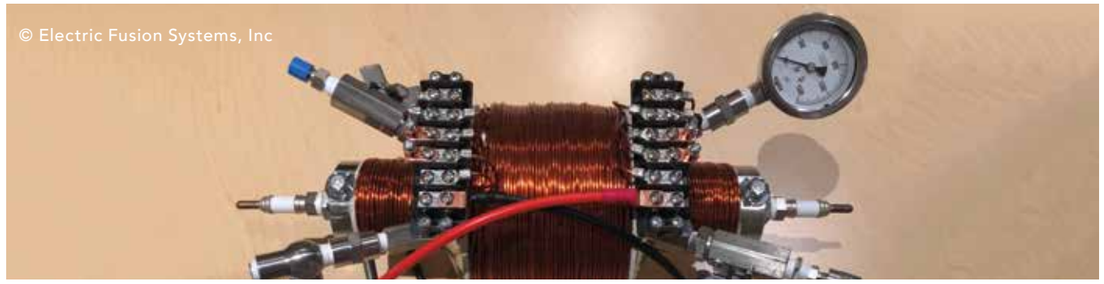
Deutelio aims to achieve nuclear fusion by magnetic confinement with the Polomac configuration, using the Deuterium-Deuterium reaction. It plans a small prototype to validate and tune the magnetic tunnels within three years, to design the first nuclear reactor in five years and achieve some electricity in ten years.

Location	Grono, Switzerland (HQ); Gavirate, Italy
Contact details	info@deutelio.com
Year founded	2022
Founder names	Francesco Elio, Filippo Elio
Primary target markets	Electricity generation, Industrial Heat, District heating and electricity
Total declared funding to date	$538,000
Employees (incl. full time consultants)	4
General approach	Magnetic confinement
Specific approach	Poloidal magnetic confinement with shielded supports of the coil trapped inside the plasma, e.g. Levitron, Spherator, Intrap, LDX
Fuel source	DD
Planned energy capture approach	Liquid metal with heat exchanger
Pilot plant timescale	2028: first nuclear D-D pilot power plant 10 MW for heat production. 2029: sales for district heating, food industry, agriculture green houses and pools. 2033: upgrade for electricity generation.
Anticipated MWe of your commercial operating facility	30 MWe
Milestones in past 12 months	Preliminary results of the full MHD simulation.
Key collaborators/partners	Cross-Ing AG (CH); OpenIndustria (IT); Università della Tuscia (IT); W2W Solutions (IT)

ELECTRIC FUSION SYSTEMS, INC.

Electric Fusion Systems was formed out of the founders' mutual investigations of proton-lithium fusion and insights on how to virtually eliminate the coulomb barrier with Rydberg matter. We use a supercritical dense liquid metal fuel condensate to create an ultra-low cost (<$5/MWh) direct-to-electricity scalable aneutronic fusion power generator.

Location	Broomfield, Colorado, USA
Contact details	info@electricfusionsystems.com
Year founded	2020
Founder names	Ken E. Kopp, Ryan S. Wood
Primary target markets	Electricity generation, Off-grid energy
Total declared funding to date	$400,000
Employees (incl. full time consultants)	4
General approach	Heavy Rydberg matter fuel-based fusion, not traditional hot fusion
Specific approach	Pulsed magneto-plasma pressurized confinement
Fuel source	Lithium
Planned energy capture approach	Direct energy conversion
Pilot plant timescale	2025
Anticipated MWe of first commercial operating facility	5kW to 100MW depending on number of cartridges and modules
Interim plants or facilities planned	Small scale roller-bag sized 2-5kW pilots for 3rd party testing.
Milestones in past 12 months	Now four pending patents. The latest is on heavy Rydberg matter fusion fuel processing.
Key collaborators/partners	Energy Research Center; Voss Scientific
Recent spin outs/patents/commercial innovations	- Aneutronic Fusion Plasma Reactor and Electric Power Generator PCT/US2022/53859. - Magnetohydrodynamic Cavitation Fusion Energy Generator PCT IS2021/057875.



ENERGY SINGULARITY FUSION POWER TECHNOLOGY

Energy Singularity was founded in 2021 in Shanghai, China. We are focusing on the R&D of high-field, high-confinement and compact tokamak with HTS magnets.

Location	Pudong, Shanghai, China
Contact details	bd@energysingularity.cn
Year founded	2021
Founder names	Zhao Yang
Primary target markets	Electricity generation
Total declared funding to date	$112,418,000
Employees (incl. full time consultants)	120
General approach	Magnetic confinement
Specific approach	Tokamak
Fuel source	DT
Planned energy capture approach	Lithium neutron ‘blanket’
Anticipated MWe of your commercial operating facility?	500MWe
Interim plants or facilities planned	We plan to build a high-field HTS tokamak (HH170) to demonstrate Q≥10 over the next 3-4 years.
Milestones in past 12 months	We completed the construction of HH70 and the first plasma was obtained. HH70 is the world’s first HTS tokamak in operation, with B of 0.6T and R of 0.75m. HH70 is composed of 26 magnets (12 TF, 8 CS and 6 PF), all of which are made from YBCO tapes.

ENN

ENN is committed to generating fusion energy in an environment-friendly and cost-effective manner. A number of devices are being designed and built to support our vision for commercial ST p-11B fusion.

Location	Langfang, Hebei, China
Contact details	qixudong@enn.cn
Year founded	ENN Science and Technology Development Co., Ltd founded in 2006. ENN Fusion Technology R&D Center founded in 2018
Founder names	Yusuo Wang
Primary target markets	Electricity generation
Total declared funding to date	$400,000,000
Employees (incl. full time consultants)	150
General approach	Magnetic confinement
Specific approach	Spherical tokamak
Fuel source	pB11
Planned energy capture approach	Direct energy conversion
Anticipated MWe of your commercial operating facility?	200MWe

EX-Fusion

FIA MEMBER

EX-FUSION

EX-Fusion is the first and only full-stack laser fusion company from Japan. The company currently is focused on R&D in three areas: First, laser driver capable of high-power, high-repetition operations; Second, beam control for high power laser systems; and third, blanket and first wall (lead-lithium) material production. It aims to have a commercial laser fusion plant operational by 2035.

Location	Osaka, Japan (HQ); Shizuoka, Japan (R&D); Adelaide, Australia; San Francisco, California, USA
Contact details	info@ex-fusion.com
Year founded	2021
Founder names	Dr. Kazuki Matsuo, Dr. Yoshitaka Mori, Dr. Shinsuke Fujioka
Primary target markets	Electricity generation, Hydrogen and/or clean fuels
Total declared funding to date	$12,200,000
Employees (incl. full time consultants)	37
General approach	Inertial confinement
Specific approach	Laser-driven inertial confinement
Fuel source	DT
Planned energy capture approach	Liquid metal with heat exchanger
Pilot plant timescale	2030 for demo facility to prove the commercial viability of Fast-Ignition IFE
Anticipated MWe of your commercial operating facility?	200MWe (by 2035), 1.4GWe (by 2045)
Interim plants or facilities planned	2024 – Integrated Operation Experimental Device (Completed). 2027 – Continuous Operation Technology Demonstrator. 2030 – Fusion Power Generation Demonstration Reactor. 2035 – 200MWe Commercial-grade FPP (Fusion Power Plant). 2045 – 1.4GWe Highly Competitive Large-scale FPP.
Milestones in past 12 months	Officially commenced operations at the Integrated Operation Experimental Device site in Hamamatsu, Japan in April 2024. This facility integrates 10Hz laser, 10Hz target injection, and 10Hz adaptive optics and tests the integrated operation of the various systems.
Recent spin outs/patents/commercial innovations	- Application of the high-power pulse lasers for space debris tracking (<10cm in size). - Commercial development of Japan-made laser cutting machine with high precision (<50μm Heat Affected Zone) for automotive parts production. - Altering liquid metal circulation to allow desalination of seawater and mineral (e.g. lithium) extraction from seawater.

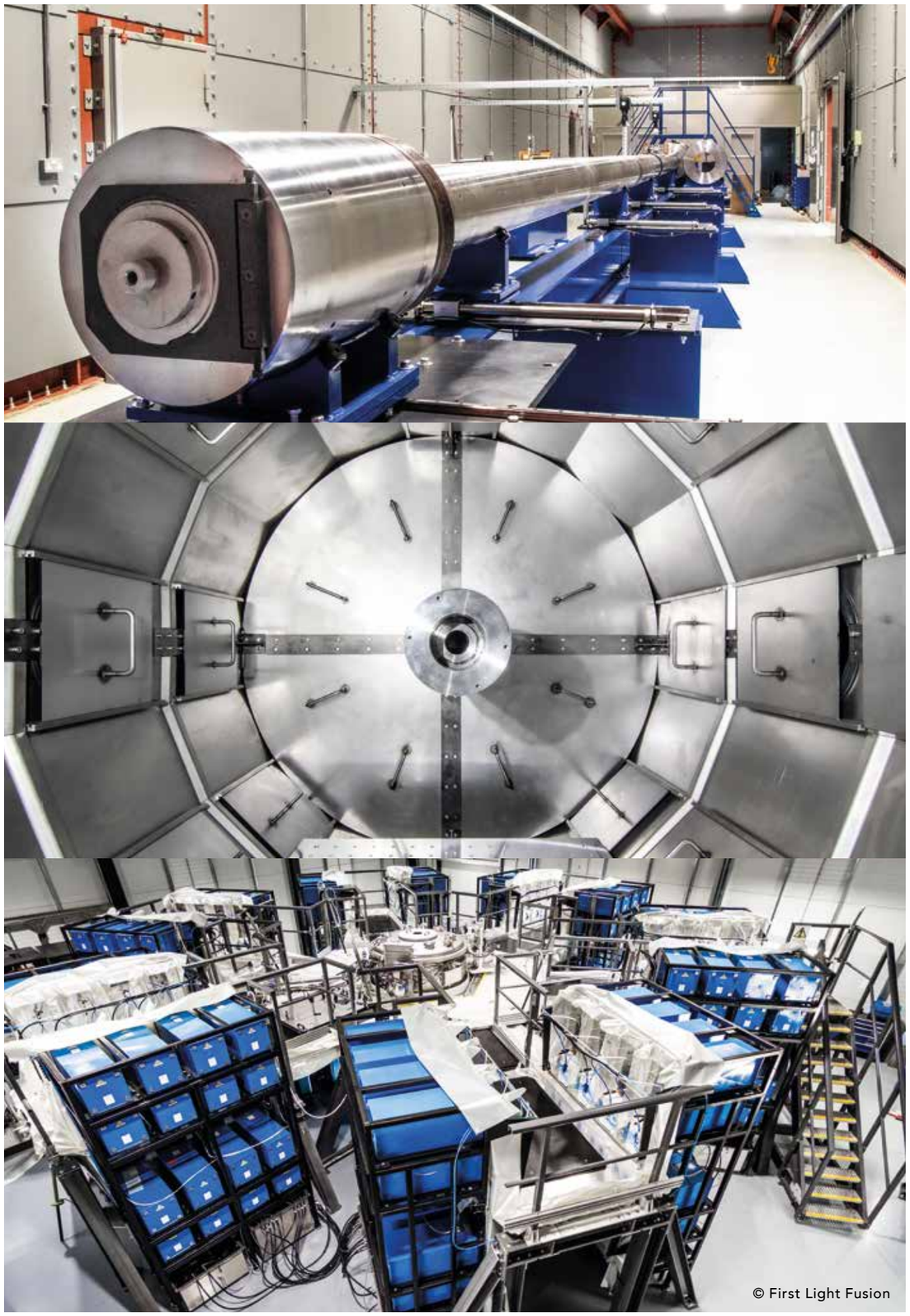
first light

FIA MEMBER

FIRST LIGHT FUSION

Progressing an inertial fusion energy concept using amplifier technology, with a focus on the path to commercial powerplants. Solving fusion power with the simplest means possible.

Location	Oxford, UK
Contact details	enquiries@firstlightfusion.com
Year founded	2011
Founder names	Dr Nicholas Hawker, Prof Yiannis Ventikos
Primary target markets	Electricity generation
Total declared funding to date	$99,000,000
Employees (incl. full time consultants)	104
General approach	Inertial confinement
Specific approach	Shock-driven inertial confinement
Fuel source	DT
Planned energy capture approach	Lithium neutron 'blanket'
Pilot plant timescale	2032
Anticipated MWe of your commercial operating facility?	150MW to 400MW
Milestones in past 12 months	- Demonstration of amplifier performance at a 3rd party facility (Sandia). - Demonstration of flyer plate over increased distance.
Key collaborators/partners	Sandia; Imperial University; Oxford University; York University
Recent spin outs/patents/ commercial innovations	Endor Materials testing amplifier.
Recent published papers	Imaginary-time correlation function thermometry: A new, high-accuracy and model-free temperature analysis technique for x-ray Thomson scattering data; A 0-dimensional electric gun model for the optimization of flyer acceleration to hypervelocities; Point projection radiography of electromagnetically accelerated flyer plates with an external X-pinch driver.



FOCUSED ENERGY

FIA MEMBER

FOCUSED ENERGY

Focused Energy is a German American company, span out of the Technical University of Darmstadt in 2021, that will enable safe, clean, and virtually inexhaustible energy production through laser-based nuclear fusion in just a few years. The young company is based in Darmstadt and in Austin,Texas, and employs the best minds from relevant research institutes and universities in Europe and the USA. Focused Energy uses the experience of its founders gained over the past 30 years in fusion research, coupled with the speed of a young German American company and private investment, to bring laser-based fusion to market and satisfy the world's hunger for energy.

Location	Austin, Texas, USA; Darmstadt, Germany
Contact details	info@focused-energy.world
Year founded	2021
Founder names	Markus Roth, Thomas Forner
Primary target markets	Electricity generation, Off-grid energy, Hydrogen and/or clean fuels, Industrial heat, Imaging, LDRS
Total declared funding to date	$110,000,000
Employees (incl. full time consultants)	70
General approach	Inertial confinement
Specific approach	Laser-driven inertial confinement
Fuel source	DT
Planned energy capture approach	Lithium neutron 'blanket'
Pilot plant timescale	2037
Anticipated MWe of your commercial operating facility?	1000MW
Interim plants or facilities planned	1. FE Laboratory Darmstadt - Targetry lab and workshop, laser lab for laser development (2024). 2. Experimental Laser Facility in Bay Area - First experimental laser facility for proton fast ignition (2025). 3. Implosion Test Facility in Germany - Sub-scale implosion demonstrator, TRL 6, with 48 lasers, MVP (2030). 4. LDRS Demonstrator Facility in Biblis, Germany (2027).
Milestones in past 12 months	- Finished Laserdesign. - Finished Pointdesign. - Target assembly & Manufacturing. - Build Targetlab.
Recent company investments	Laser & Target Lab Facility, LDRS.
Key collaborators/partners	TRUMPF GmbH + Co. KG; Fraunhofer Society for the Advancement of Applied Research; GSI Helmholtz Centre for Heavy Ion Research; Lawrence Livermore National Laboratory; Extreme Light Infrastructure; Laser-Laboratorium Göttingen e.V.; Colorado State University; Los Alamos National Laboratory; ESS-Bilbao; Technical University of Darmstadt; Karlsruhe Institute of Technology; Amplitude Laser Group; Proxeon; Heraeus Holding GmbH; Schott AG; Oxford Sigma Ltd; Technical University of Madrid – School of Industrial Engineers; EIC Scaling Club – European Innovation Council; SPRIND – Federal Agency for Disruptive Innovation; U.S. Department of Energy; GNS Society for Nuclear Service; Federal Institute for Materials Research and Testing; Technical Inspection Association; Federal Ministry of Education and Research; Fusion Advisory Board of the German Federal Government; acatech – National Academy of Science and Engineering; EIC Scaling Club – European Innovation Council; Princeton Plasma Physics Laboratory; University of Michigan; Imperial College London; University of Alberta; Laboratory for Laser Energetics.
Recent published papers	Investigation of laser plasma instabilities driven by 527 nm laser pulses relevant for direct drive inertial confinement fusion, Physics of Plasmas, **https://pubs.aip.org/aip/pop/article/31/2/022107/3265421/Investigation-of-laser-plasma-instabilities-driven** Focused Energy, A New Approach Towards Inertial Fusion Energy, Journal of Fusion Energy, **https://link.springer.com/article/10.1007/s10894-023-00363-x**

FUSE

Fuse is building a Next Generation Pulsed Power (NGPP) machine, based on the success of the Z machine at Sandia. It is currently assembling the world's first and highest power driver (1TW) and operating a pulsed neutron generator licensed to produce >10^13 thermonuclear neutrons. Fuse is the only US company committed to MagLIF.

Location	Palo Alto, California, USA; Napierville, Quebec, Canada
Contact details	hello@f.energy
Year founded	2019
Founder names	JC Btaiche
Primary target markets	Electricity generation, Off-grid energy
Total declared funding to date	$18,000,000
Employees (incl. full time consultants)	20
General approach	Magneto-inertial
Specific approach	Magnetized Liner Inertial Fusion (MagLIF)
Fuel source	DT
Planned energy capture approach	Molten salt (FLiBe) with heat exchanger
Pilot plant timescale	late 2020s, early 2030s
Anticipated MWe of first commercial operating facility	~300MW

GAUSS FUSION

Gauss Fusion is a European green technology company aiming to produce clean fusion energy as the ultimate base-load power renewable in a solar-wind-fusion trio. It was founded in 2022 by medium-sized companies from France, Germany, Italy, and Spain, all of them with industrial expertise in fusion technologies.

Location	Garching/Munich, Germany
Contact details	info@gauss-fusion.com
Year founded	2022
Founder names	IDOM, Bruker EAS, Hofima (ASG), Alcen, RI Research Instruments, among others.
Primary target markets	Electricity generation
Total declared funding to date	$18,200,000
Employees (incl. full time consultants)	20
General approach	Magnetic confinement
Specific approach	Stellarator
Fuel source	DT
Planned energy capture approach	Lithium neutron 'blanket'
Pilot plant timescale	2040s
Anticipated MWe of first commercial operating facility	1000MW
Interim plants or facilities planned	The plan is not to have any interim plants.
Recent company investments	- Start of demountable coil project funded by BmBF. - Hiring of key technical staff and initiation of strategic partnerships.
Key collaborators/partners	IDOM, Bruker EAS, ASG, Alcen, RI Research Instruments, IPP, KIT, CERN, ENEA

generalfusion

FIA MEMBER

GENERAL FUSION

General Fusion is pursuing commercial fusion energy with Magnetized Target Fusion (MTF) technology. Headquartered in Richmond, B.C., the company is accelerating its progress by building a fusion demonstration machine, called Lawson Machine 26 (LM26). LM26 is designed to achieve first-of-a-kind breakthroughs in 2025 and 2026 that will de-risk and fast-track the path to commercialization.

Locations	Richmond, British Columbia, Canada (HQ); London, UK (subsidiary); Tennessee, USA (subsidiary)
Contact details	info@generalfusion.com
Year founded	2002
Founder names	Dr Michel Laberge
Primary target markets	Electricity generation
Total declared funding to date	$325,000,000
Employees (incl. full time consultants)	140
General approach	Magneto-inertial
Specific approach	Magnetized Target Fusion
Fuel source	DT
Planned energy capture approach	Liquid metal with heat exchanger
Pilot plant timescale	Underway: MTF machine—LM26—launched in 2023 and being assembled in Richmond, B.C. LM26 is designed to achieve fusion conditions of over 100 million degrees Celsius by 2025, with a goal of achieving scientific breakeven equivalent by 2026. The data gathered from LM26 will be incorporated into the design of the company's planned commercial-scale machine. Early-to-mid 2030s: First commercial fusion power plant.
Anticipated MWe of first commercial operating facility	Approx. 300MWe from two machines operating in-tandem
Interim plants or facilities planned	[N/A; same response as "Pilot plant timescale" section above.]
Milestones in past 12 months	As part of the LM26 demonstration program: - Achieved symmetrical compression of a solid lithium ring—the first major project milestone for LM26 and a necessary step to scaling up for the full-scale compression system. - Advanced to a new testbed, Prototype 0 (P0), which uses magnetic force to compress the solid lithium liner in a small-scale version of the LM26 compression system and provides critical data to de-risk LM26. - 30 P0 compression tests completed as of June 5, 2024. - The testbed successfully reached its max operations for shaft current, liner temperature, and compression capacitor bank energy. - Assembled a full suite of diagnostics to analyze each liner compression, providing data to improve alignment between experimental results and modelling and simulation. - Progressed several diagnostics to measure plasma temperature and density in the LM26 plasma injector.
Recent company investments	General Fusion launched its LM26 MTF demonstration program in 2023 and began operations on its compression prototype, Prototype 0 (P0), in the fall. The results from P0 provide critical data that is being integrated into the design of LM26's large-scale compression system.

Key collaborators/partners	Selected partners and suppliers: Bertin Technologies; Canadian Nuclear Laboratories; General Atomics; Hatch; University of Illinois; University of Lisbon; Lawrence Livermore National Laboratory; McGill University; Motus Design; Oak Ridge National Laboratory; Princeton Plasma Physics Laboratory; Queen's University; Savannah River National Laboratory; Simon Fraser University; TRIUMF; United Kingdom Atomic Energy Authority; University of Waterloo Market Development Advisory Committee: ACEN; Bruce Power; Duke Energy; E.ON; Eneco; Engie; H2 Green Steel; Renexia; Southern Company; Tennessee Valley Authority
Recent spin outs/patents/commercial innovations	190 patents and patents pending.
Recent published papers	Modeling and simulation of lithium transport and radiation in diverted Pi3 plasmas." Physics of Plasmas 30.7 (2023). - **https://doi.org/10.1063/5.0153107** "Shape manipulation of a rotating liquid liner imploded by arrays of pneumatic pistons: Experimental and numerical study." Fusion Engineering and Design 198 (2024): 114087. - **https://doi.org/10.1016/j.fusengdes.2023.114087** "Diagnostics for the General Fusion LM26 Machine" white paper presented at Basic Research Needs Workshop on Measurement Innovation by US DOE Office of Fusion Energy Sciences (2024), **https://generalfusion.com/post/diagnostics-for-the-general-fusion-lm26-machine-white-paper/** "An interface tracking, finite volume code for modeling axisymmetric implosion of a rotating liquid metal liner with free surface." Physics of Fluids 36.3 (2024) **https://doi.org/10.1063/5.0196467**

HB11 ENERGY

HB11 Energy is developing commercially sustainable fusion energy that can be deployed worldwide. Our mission is to build a power plant based on laser boron fusion and set a global standard for safe fusion fuel.

Location	Sydney, Australia
Contact details	contact@hb11.energy
Year founded	2017
Founder names	Heinrich Hora, Warren McKenzie, Jan Kirchhoff
Primary target markets	Electricity generation, Hydrogen and/or clean fuels, Industrial heat
Total declared funding to date	$5,100,000
Employees (incl. full time consultants)	13
General approach	Inertial confinement
Specific approach	Direct laser-driven pB11
Fuel source	pB11
Planned energy capture approach	Liquid metal with heat exchanger
Pilot plant timescale	2030s
Anticipated MWe of first commercial operating facility	1000MW
Interim plants or facilities planned	Demonstration Facilities, showing sub systems for fast ignition
Milestones in past 12 months	- Experimental campaigns validating effective few MeV proton acceleration in subcritical aerogels. - Enabled government leveraged laser development program to design and build high power diode pumped lasers for effective proton acceleration. - Validated use of multiple established PIC and hybrid codes for simulation of pB11 fuel burn parameter space. - Advanced the process for manufacturing of hydrogen enriched boron fuel. - Progressed in engineering program for a powerplant design.
Recent company investments	N/A
Key collaborators/partners	ILE Osaka (Japan); University of Rochester (USA); University of Adelaide (Australia); Australian Nuclear Science and Technology; Organisation ANSTO (Australia)
Recent published papers	Advances in the Study of Laser-Driven Proton-Boron Fusion - F. Belloni: **https://doi.org/10.1155/2023/9824024** Physics of Plasma: From KMS Fusion to HB11 Energy and Xcimer Energy, a personal 50 year IFE perspective -T. Mehlhorn: **https://doi.org/10.1063/5.0170661** A Methodology for the Discrimination of Alpha Particles from Other Ions in Laser-Driven Proton-Boron Reactions Using CR-39 Detectors Coupled in a Thomson Parabola Spectrometer -S. Pikuz: **https://doi.org/10.1155/2023/3125787**

HELICAL FUSION CO., LTD.

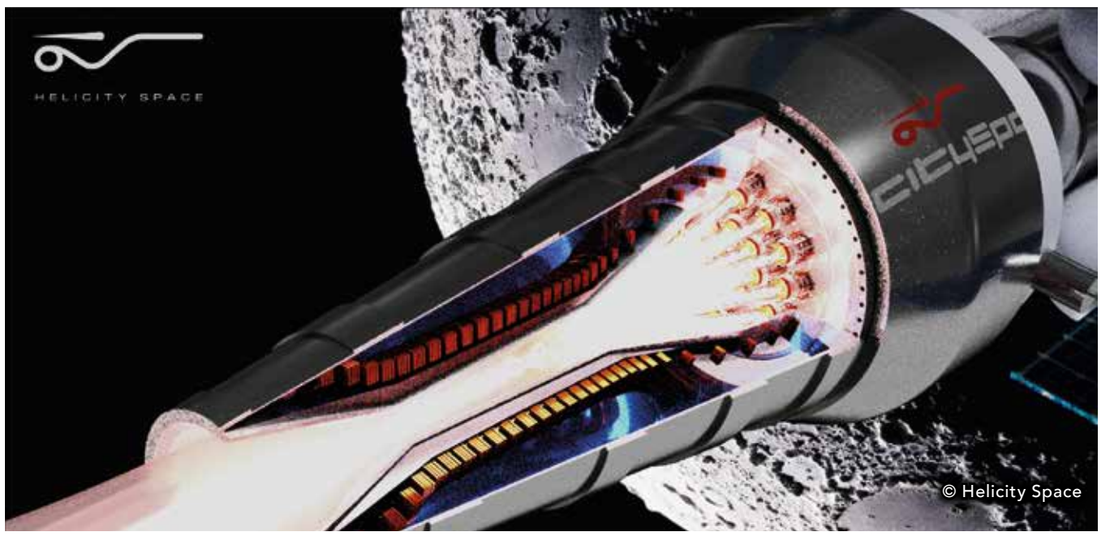
Helical Fusion (HF) is aiming to deploy fusion power plants to meet global clean energy demand. HF leverages decades of helical-stellarator research at National Institutes for Fusion Science in Japan, combined with new groundbreaking technology, such as HTS magnets and Liquid Metal blankets.

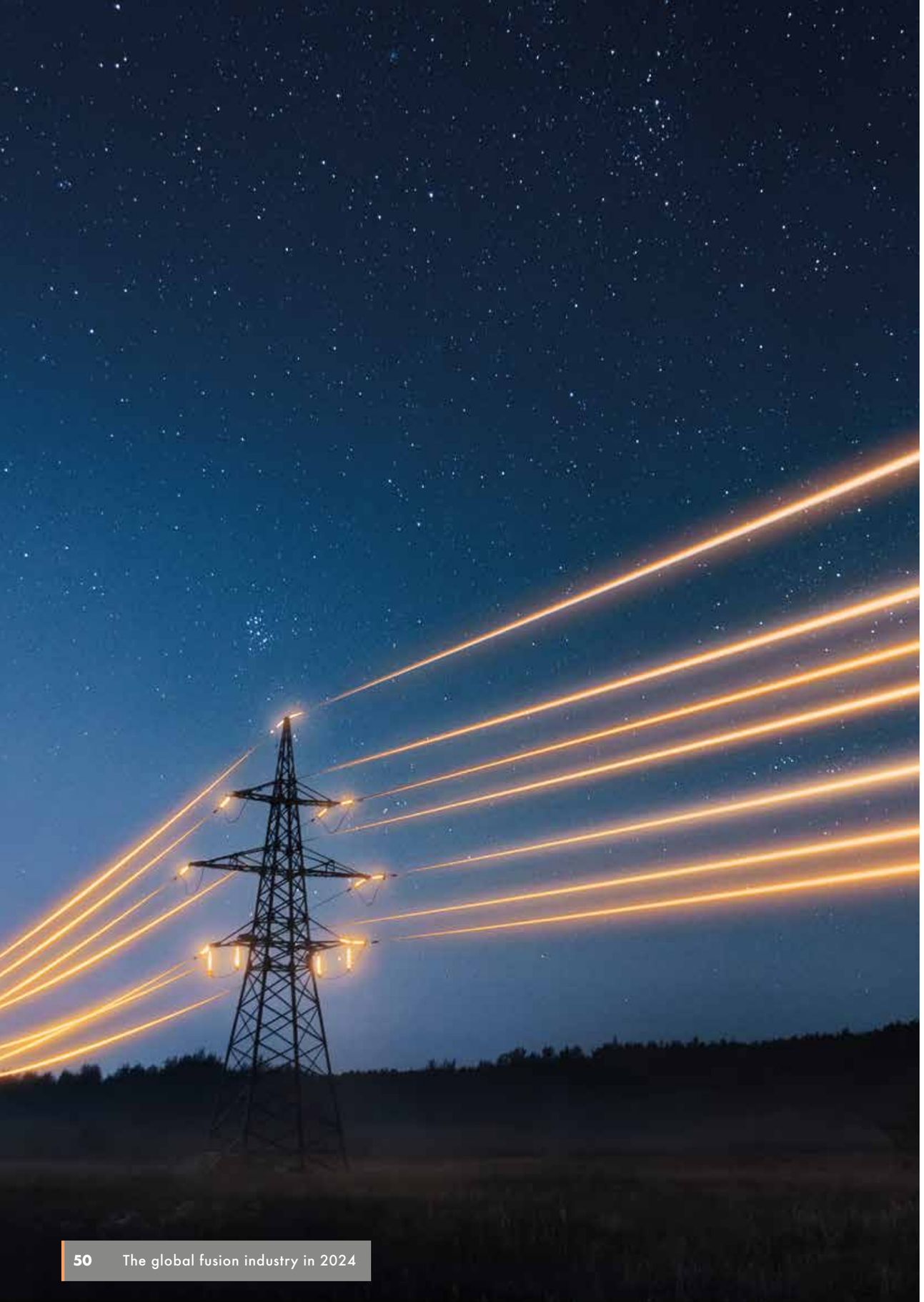
Location	Tokyo, Japan (HQ); Newark, Delaware, USA (US subsidiary)
Contact details	contact@helicalfusion.com
Year founded	2021
Founder names	Takaya Taguchi, Junichi, Miyazawa, Takuya, Goto
Primary target markets	Electricity generation, Off-grid energy
Total declared funding to date	$19,000,000
Employees (incl. full time consultants)	25
General approach	Magnetic confinement
Specific approach	Stellarator
Fuel source	DT
Planned energy capture approach	Liquid metal with heat exchanger
Pilot plant timescale	2034
Anticipated MWe of first commercial operating facility	50 - 100 MWe
Interim plants or facilities planned	Final Experimental Device: aim to demonstrate steady-state operation with its proprietary HTS magnet and Liquid Metal blanket integrated into a plant.
Milestones in past 12 months	Success of HTS cable current test in Q1 2024 (19kA, 8T, 20K) with min bend radii 4cm.
Recent company investments	- Test HTS cable. - Test module of Liquid Metal blanket system.
Key collaborators/partners	- Strategic partnership agreement with National Institute for Fusion Science (NIFS) - Joint research with NIFS; Tokyo University; Tohoku University; Aoyama University; Tokushima University; etc. - Various partnerships with Japanese manufacturing companies
Recent published papers	[1] Development of steady-state fusion reactor by Helical Fusion, Phys. Plasmas 30, 050601 (2023) [2] Effects of Cr and Si addition on the high-temperature oxidation resistance in high-Mn alumina-forming oxide dispersion strengthened austenitic steels, Nuclear Materials and Energy Volume 38, March 2024, 101572

HELICITYSPACE CORPORATION

Helicity Space Corporation is a privately funded company dedicated to developing compact fusion space propulsion and the power systems of a spacefaring civilization. The vision is to enable space colonization and a clean Earth with fusion power and propulsion technology.

Location	Pasadena, California, USA
Contact details	marta.calvo@helicityspace.com
Year founded	2018
Founder names	Stephane Lintner, Marta Calvo, Setthivoine You
Primary target markets	Space propulsion
Total declared funding to date	$7,600,000
Employees (incl. full time consultants)	7
General approach	Magneto-intertial
Specific approach	Plectoneme
Fuel source	DD
Planned energy capture approach	Lithium neutron ‘blanket’
Anticipated MWe of your commercial operating facility?	300MW
Milestones in past 12 months	Full operation of proof-of-principle device.
Recent company investments	Building up diagnostics in the lab.
Key collaborators/partners	Caltech; UMBC; LANL; Swarthmore College





HELION

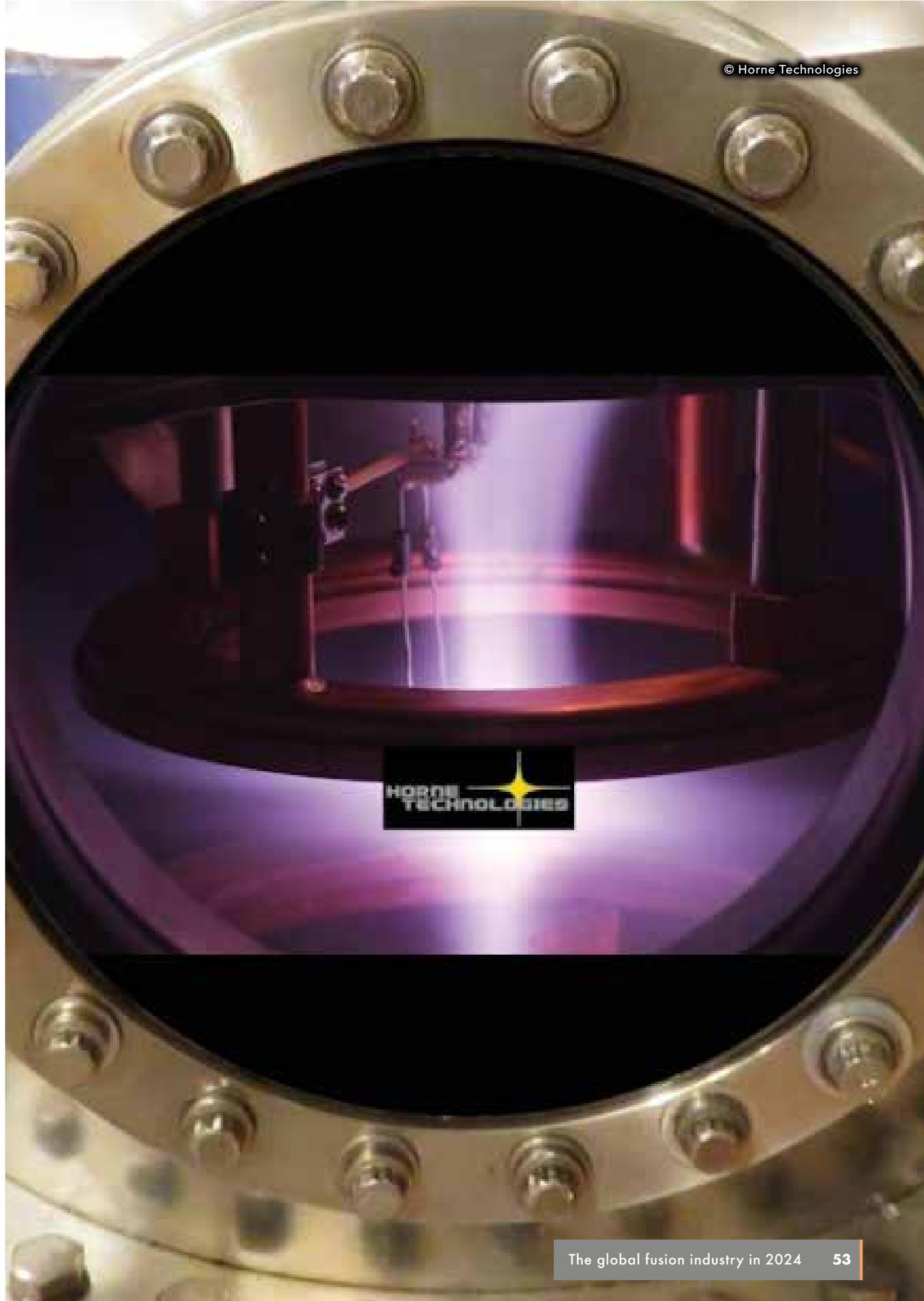
Building the world's first fusion power plant to enable a future with unlimited clean electricity.

Location	Everett, Washington, USA
Contact details	inquiries@helionenergy.com
Year founded	2013
Founder names	David Kirtley, Chris Pihl, George Votroubek, John Slough
Primary target markets	Electricity generation
Total declared funding to date	$600,000,000
Employees (incl. full time consultants)	300
General approach	Magneto-intertial
Specific approach	Field Reversed Configuration
Fuel source	DHe3
Planned energy capture approach	Direct energy conversion
Pilot plant timescale	2028
Anticipated MWe of your commercial operating facility?	At least 50 MWe
Milestones in past 12 months	- Formed the first plasmas and FRCs in our Plasma Injector test. - Built up in-house capacitor manufacturing capabilities; producing more than 40 high-voltage pulsed capacitors per week. - Built full sections of Polaris, our 7th fusion prototype, and now preparing for testing.
Key collaborators/partners	Microsoft; Nucor
Recent spin outs/patents/commercial innovations	High-energy particulate resistors: h**ttps://patentimages.storage.googleapis.com/ff/fb/a8/611e479728cf11/LU502264B1.pdf**
Recent published papers	Fundamental Scaling of Adiabatic Compression of Field Reversed Configuration Thermonuclear Fusion Plasmas. J Fusion Energy 42, 30 (2023). **https://doi.org/10.1007/s10894-023-00367-7**

HORNE TECHNOLOGIES, INC.

Horne Technologies is targeting rapid and affordable advancement of fusion technology for near-term energy and neutron production. Horne Technologies' hybrid approach enables low-cost iteration with fusion-capable, continuously operating devices. Recently with positive results, we are accelerating development and will have a high-power device online in 2024.

Location	Longmont, Colorado, USA
Contact details	hornetech@protonmail.com
Year founded	2008
Founder names	Tanner Horne
Primary target markets	Electricity generation, Space propulsion, Marine propulsion, Medical, Hydrogen and/or clean fuels, Industrial heat
Total declared funding to date	$3,150,000
Employees (incl. full time consultants)	5
General approach	Hybrid Magnetic/Electrostatic Confinement
Specific approach	Spindle cusp, superconducting shielded-grid IEC
Fuel source	DD, DT, pB11
Pilot plant timescale	3-5 years
Anticipated MWe of your commercial operating facility?	1-100MWe
Interim plants or facilities planned	New facility completed 2022, which satisfies needs until pilot plant.
Milestones in past 12 months	Experiments are ongoing with positive results. - Higher power ion injection system installed. - Patent issued. - High power device, with higher power magnets and 40keV (460 million C) temperatures, online 2024.
Recent company investments	- Major investments in cryogenics, software, facilities, and vacuum systems. - Major investment and advancement in designs for manufacturing and scaling.
Recent spin outs/patents/ commercial innovations	US Patent # 11,948,696.



KYOTO FUSIONEERING

Kyoto Fusioneering Ltd. (KF), a multinational company headquartered in Japan, complements global fusion development programs by providing fusion power plant design and engineering services, and designing and supplying confinement concept agnostic fusion-grade technology and integrated fuel cycle, thermal cycle, and plasma heating systems.

By parallelizing the development of critical path fusion power plant systems, KF is enabling an accelerated path to commercially viable fusion.

Location	Kyoto Fusioneering Ltd.: Tokyo, Japan (HQ); Kyoto, Japan (R&D) **Subsidiaries:** Kyoto Fusioneering America Ltd.: Seattle, Washington, USA Kyoto Fusioneering UK Ltd.: Reading, UK Kyoto Fusioneering Europe GmbH: Karlsruhe, Germany Fusion Fuel Cycles Inc.*: Ontario, Canada *Joint venture with Canadian Nuclear Laboratories
Contact details	info@kyotofusioneering.com
Year founded	2019
Founder names	Satoshi Konishi, Taka Nagao, Richard Pearson, Shutaro Takeda
Primary target markets	Electricity generation, Industrial heat
Total declared funding to date	$90,000,000
Employees (incl. full time consultants)	140
General approach	Agnostic
Planned energy capture approach	Lithium neutron 'blanket'
Pilot plant timescale	N/A – KF will be ready to provide technologies for developers pursuing construction of a fusion power plant by the end of the 2020s.
Anticipated MWe of commercial operating facility	N/A
Interim plants or facilities planned	- Early operations have begun at UNITY-1 (UNique Integrated Testing facilitY for fusion thermal/power cycle) – a non-radiological blanket component and thermal cycle test and user facility at KF's Kyoto Research Center (KRC) in Kyoto, Japan. The full-scale testing campaigns are expected to commence in mid-2025. - UNITY-1 will allow users to mount scaled blanket test articles (integrated blanket modules, manifolds, and components) between 4 T superconducting magnets, connected to a flowing LiPb loop that's heated to 1000 °C via surface heating. - UNITY-2, a full deuterium-tritium fuel cycle test loop in Ontario, Canada, expects to start operations by mid-2026.
Milestones in past 12 months	- Successful Commissioning of UNITY-1 base loop. - Approved Design of UNITY-2. - Successful Gyrotron Delivery to UKAEA. - Technical collaboration with UKAEA on blanket design: two separate studies based on advancing blanket design, including methodology, modelling and analysis. - Engaged in significant agreement with UKAEA to conduct irradiation testing and post-irradiation examination of SiC/SiC fibre composites produced by KF. - High-Temperature Superconducting Magnets Development, in collaboration with Fujikura and UKAEA.
Recent company investments	UNITY-1. UNITY-2.
Recent published papers	Advancing Fusion Technology: Kyoto Fusioneering's Approach to Accelerating Commercial Viability **https://kyotofusioneering.com/en/whitepaper**

FIA MEMBER

LASERFUSIONX INC.

Advance direct drive laser fusion energy using the deep UV ArF laser the ArF laser

Location	Springfield, Virginia, USA
Contact details	laserfusionx@outlook.com
Year founded	2022
Founder names	Stephen Obenschain
Primary target markets	Electricity generation
Total declared funding to date	$200,000
Employees (incl. full time consultants)	2
General approach	Inertial confinement
Specific approach	Laser-driven inertial confinement
Fuel source	DT
Planned energy capture approach	Lithium neutron ‘blanket’
Pilot plant timescale	16 years
Anticipated MWe of your commercial operating facility?	400 MW pilot power plant
Interim plants or facilities planned	30 kJ Argon Fluoride laser beamline, 650 kJ ArF laser direct-drive high-gain implosion facility
Milestones in past 12 months	Advanced reactor design with innovative solid blanket design and magnetic intervention to protect 1st wall from ions – accepted for publication in the Journal of Fusion Energy. “Direct Drive LaserFusion Facility and Pilot Power Plant.”
Key collaborators/partners	AE Blue Capital, PLEX LLC

LONGVIEW FUSION
ENERGY SYSTEMS

FIA MEMBER

LONGVIEW FUSION ENERGY SYSTEMS

Longview Fusion Energy Systems will construct the world's first laser fusion power plant. Building upon the groundbreaking fusion energy with gain demonstrations at Lawrence Livermore National Laboratory's National Ignition Facility, Longview is the only fusion energy company employing this proven fusion energy approach. Our plant will provide carbon-free, safe, and cost-effective laser fusion energy, serving as a model for future plants that can be deployed nationwide and internationally.

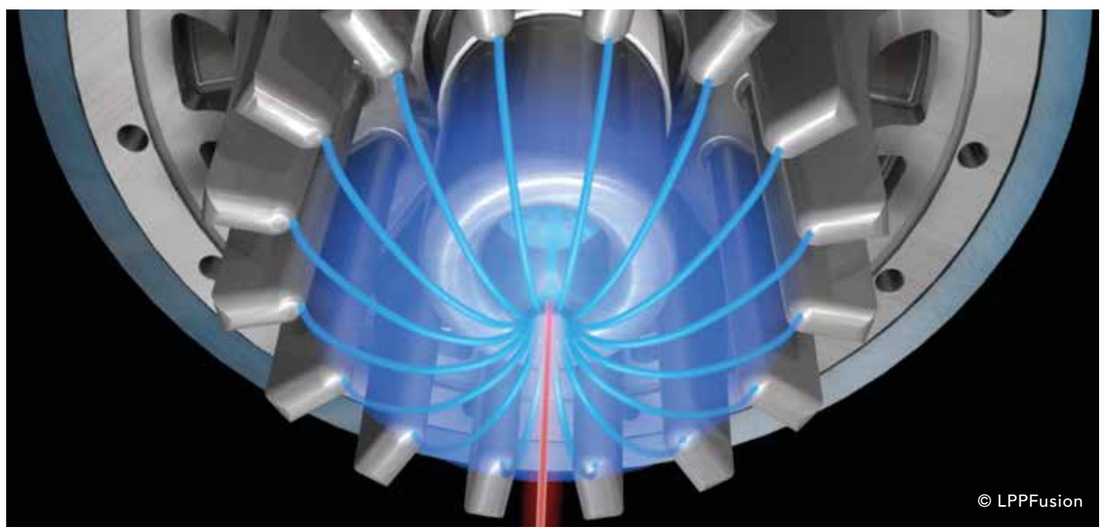
Location	Livermore, California, USA
Contact details	info@longviewfusion.com
Year founded	2021
Founder names	Edward Moses, Aaron Khandros, Igor Khandros
Primary target markets	Electricity Generation and Industrial Heat
Employees (incl. full time consultants)	15
General approach	Inertial confinement
Specific approach	Laser-driven inertial confinement
Fuel source	DT
Planned energy capture approach	Liquid metal with heat exchanger
Pilot plant timescale	Our commercialization goal is to design and build a Fusion Pilot Plant (FPP) to be operational in the mid-2030s, based on fusion physics demonstrated on the National Ignition Facility (NIF).
Anticipated MWe of first commercial operating facility	Designs developed with range of 440MWe to 1600MWe to the grid.
Interim plants or facilities planned	(i) Physics: Longview will be using the National Ignition Facility to demonstrate the required physics performance. Already, and uniquely among all fusion schemes to date, the NIF has demonstrated fusion energy with net scientific gain, Qsci>1, and multiple shots demonstrating a burning plasma and ignition using the same hohlraum-based approach being adopted by Longview. (ii) Rep-rated operation: A high-fidelity integrated laser-target engagement demonstration facility ("Big Shot") using a full-scale laser beamline and target injector, operating at the plant repetition rate.
Milestones in past 12 months	(A) Following the seminal achievement of net fusion gain (Qsci>1) and ignition in December 2022, the National Ignition Facility (NIF) has reproduced and increased the fusion energy gain multiple times. This is the only system in the world to enter the burning plasma regime and net gain. (B) A gain of 2.4 was demonstrated in February 2024, representing a factor-2 increase in performance. (C) Uniquely, Longview's Market Entry Plant (MEP) directly uses this mode of ignition, with design work showing the need for an initial gain of just 10 to 15. Models benchmarked on the NIF show that this needs modest increases in the target coupling efficiency, from ~12% to ~16%, via minor geometrical changes to the shape of the target.
Key collaborators/partners	- DOE: Lawrence Livermore National Laboratory; Savannah River National Laboratory; Oak Ridge National Laboratory - Industrial: Fluor Corporation; several laser system technology partners; General Atomics - Workforce development and education: University of Oklahoma; University of New Mexico; Prairie View A&M; University of Science and Arts Oklahoma - Community guidance: Chickasaw Tribal Nation - Legal and Regulatory: Pillsbury Winthrop Shaw Pittman LLC - Economic analysis: Bates White
Recent published papers	The following papers in Physical Review Letters strongly support the Longview approach: 1) Achievement of Target Gain Larger than Unity in an Inertial Fusion Experiment, Phys. Rev. Lett. 132, 065102 – Published 5 February 2024 2) Energy Principles of Scientific Breakeven in an Inertial Fusion Experiment, Phys. Rev. Lett. 132, 065103 – Published 5 February 2024 3) Design of the first fusion experiment to achieve target energy gain >1, Phys. Rev. E 109, 025204 – Published 5 February 2024 4) Observations and properties of the first laboratory fusion experiment to exceed a target gain of unity, Phys. Rev. E 109, 025203 – Published 5 February 2024 5) Hohlraum Reheating from Burning NIF Implosions, Phys. Rev. Lett. 132, 065104 – Published 5 February 2024

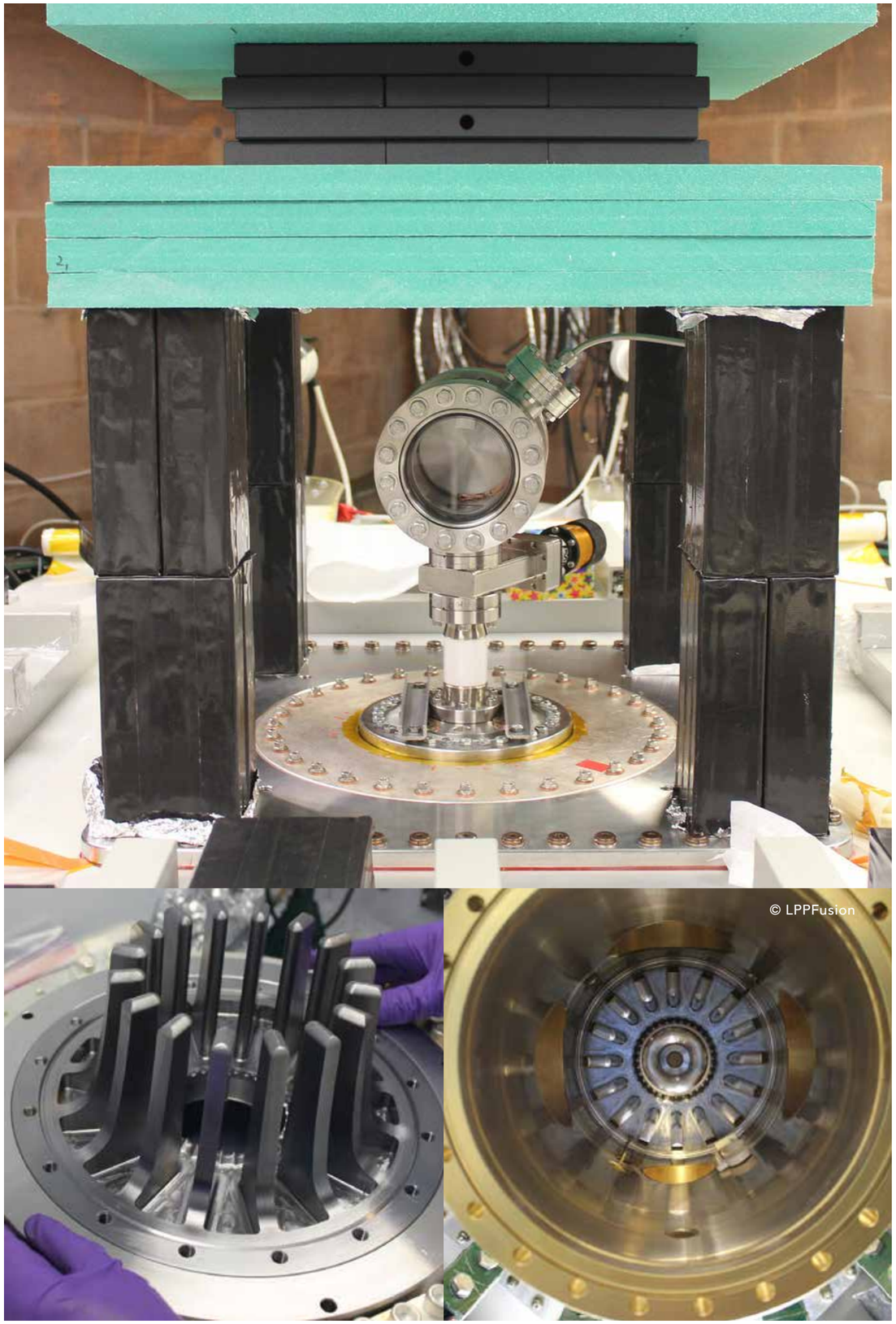
FIA MEMBER

LPPFUSION, INC.

Fusion R&D with a view to developing the fastest route to fusion, using techniques based on the Dense Plasma Focus device and hydrogen-boron fuel.

Location	Middlesex, New Jersey, USA
Contact details	fusionfan@lppfusion.com
Year founded	2003
Founder names	Eric J. Lerner
Primary target markets	Electricity generation, Space propulsion, Marine propulsion, Off-grid energy, Industrial heat
Total declared funding to date	$10,614,000
Employees (incl. full time consultants)	3
General approach	Magnetic confinement
Specific approach	Dense Plasma Focus
Fuel source	pB11
Planned energy capture approach	Direct energy conversion
Pilot plant timescale	2028
Milestones in past 12 months	Increased peak current by 60% for same input energy. Large reduction in electrode erosion. Preliminary detection of high electron temperature.
Recent published papers	**https://pubs.aip.org/aip/pop/article/30/12/120602/2928807/What-are-the-fastest-routes-to-fusion-energy**





FIA MEMBER

MAGNETO INERTIAL FUSION TECHNOLOGIES, INC. (MIFTI)

MIFTI is trying to achieve fusion energy, based on the idea of stabilized Staged Z-pinch, where a high Z-liner implodes on a fusible target by multi-MA current machines. This approach will produce a compact, low cost and scalable reactor, which MIFTI hopes will provide the fastest path to achieve fusion power.

Location	Tustin, California, USA
Contact details	contact@miftec.com
Year founded	2009
Founder names	Hafiz Ur Rahman, Norman Rostoker, Jerry Simmons, Mohammad Arshad
Primary target markets	Electricity generation, Hydrogen and/or clean fuels
Total declared funding to date	$15,000,000
Employees (incl. full time consultants)	5
General approach	Magneto-Inertial
Specific approach	Z-pinch
Fuel source	DT
Planned energy capture approach	Lithium neutron 'blanket'
Pilot plant timescale	2030
Anticipated MWe of your commercial operating facility?	50 MWe
Interim plants or facilities planned	Production of Radio Isotopes for nuclear medicine.
Milestones in past 12 months	Conducted experiments on 3MA Double Eagle pulsed driver and obtained the highest DD-neutron fusion yield of 2x10^11. Also produced the most stable pinches ever.
Recent company investments	Construction of 1MA LTD pulsed power facility in collaboration with UCSD.
Key collaborators/partners	UCSD; L3Harris; LLNL; University of Rochester; Cornell University; University of Nevada, Reno
Recent published papers	1. "Measurements of Neutrons Created in a Staged Z-Pinch With Krypton Liner and Deuterium Target at a 1-MA Pulsed Power Generator", IEEE Transaction On Plasma, Sc. 51, 3310(2023). 2. Staged Z-pinch radiation-hydrodynamic simulations on a 20-MA driver Phys. Of Plasmas, 31, 32705(2024). 3. "Feasibility and performance of the staged Z-pinch: A one dimensional study with FLASH and MACH2", Phys. Of Plasmas, 31, 42712(2024).

MARVEL FUSION

Marvel Fusion pursues a direct drive inertial fusion energy approach, with the goal of commercialising fusion energy. Highly intense short-pulsed lasers and proprietary nanostructured fuel targets enable a highly efficient fusion process, with a clear path to commercialization.

Location	Munich, Germany
Contact details	info@marvelfusion.com
Year founded	2019
Founder names	Moritz von der Linden, Dr. Georg Korn, Dr. Karl-Georg Schlesinger, Dr. Pasha Shabalin
Primary target markets	Electricity generation, Off-grid energy, Hydrogen and/or clean fuels, Industrial heat
Total declared funding to date	$200,000,000
Employees (incl. full time consultants)	70
General approach	Inertial confinement
Specific approach	Short-Pulse Laser-Driven Inertial Confinement
Fuel source	Mixed Fuels
Planned energy capture approach	Liquid metal with heat exchanger
Pilot plant timescale	2032
Anticipated MWe of your commercial operating facility?	300-800MWe
Interim plants or facilities planned	2027: Proof-of-Technology Demonstration facility constructed.
Milestones in past 12 months	- Conceptual laser design finalized. - Conceptual design demonstration facility finalized. - Nano-accelerator prototype targets produced and tested.
Key collaborators/partners	Siemens Energy; Thales; BASF; Ludwig Maximilians University of Munich; Extreme Light Infrastructure for Nuclear Physics; German Federal Agency for Disruptive Innovation (SPRIND)
Recent published papers	**https://www.nature.com/articles/s41598-023-45208-x** **https://journals.aps.org/prresearch/accepted/4c07eJ0cZ401df0ea2b640951631bed4703ca8e1e** **https://opg.optica.org/abstract.cfm?uri=cleo_europe-2023-cg_p_13**

NEARSTAR FUSION INC.

NearStar Fusion is developing Magnetized Target Impact Fusion (MTIF) power plants, using staged plasma armature railguns to drive pulsed fusion reactions using magnetized D-D fuel targets. Our simple modular approach will enable development of a utility scale power plant in a decade and performance growth to use advanced fusion fuels.

Location	Chantilly, Virginia, USA
Contact details	howdy@nearstarfusion.com
Year founded	2021
Founder names	Doug Witherspoon, Chris Faranetta
Primary target markets	Electricity generation, Off-grid energy
Total declared funding to date	$850,000
Employees (incl. full time consultants)	5
General approach	Magneto-inertial
Specific approach	Magnetized Target Impact Fusion
Fuel source	DD, D-He-3, pB-11
Planned energy capture approach	Liquid metal with heat exchanger
Pilot plant timescale	2030
Anticipated MWe of your commercial operating facility?	50MWe and larger
Milestones in past 12 months	- Side-Injector Plasma Gun development. - Development and testing of D-D fuel magnetized target impact fusion (MTIF).
Key collaborators/partners	University of Alabama in Huntsville (UAH); National Science Foundation (NSF); Virginia Innovation Partnership Corporation (VIPC)

NOVATRON FUSION GROUP AB

Fusion power to the grid through industrialization of a novel fusion reactor concept.

Location	Stockholm, Sweden (HQ); subsidiaries in UK and US being set up
Contact details	info@novatronfusion.com
Year founded	2019
Founder names	Jan Jäderberg
Primary target markets	Electricity generation, Industrial heat
Total declared funding to date	$15,000,000
Employees (incl. full time consultants)	40
General approach	Magnetic confinement
Specific approach	Open magnetic confinement (Mirror machine)
Fuel source	DT
Planned energy capture approach	Lithium neutron 'blanket'
Pilot plant timescale	2035-2039
Anticipated MWe of your commercial operating facility?	1000-1500MW
Interim plants or facilities planned	2024: Novatron 1 - Validation of plasma confinement method (stable plasma). 2027: Novatron 2 - Fusion conditions, DD-reactions detected. 203X: Novatron 3 - Continuous fusion, DT-fuel, Q=1. 203Y: Novatron 4 - Full scale commercial fusion power plant.
Milestones in past 12 months	- X0 (subsystems infrastructure for Novatron 1) completed and first plasma achieved. - Novatron 1 in final stages of assembly.
Recent company investments	- Procurement of components and subsystems for Novatron 1. - Lab infrastructure. - Company development.
Key collaborators/partners	KTH Royal Institute of Technology; UKAEA; InnoEnergy; KIPT; Oxford Sigma; Tsukuba University

NT-TAO COMPACT FUSION

NT-Tao is focused on breakthrough compact fusion technology, with the goal to democratize clean and affordable energy worldwide.

Location	Hod Hasharon, Israel
Contact details	mail@nt-tao.com
Year founded	2019
Founder names	Oded Gour-Lavie, Doron Weinfeld, Boaz Weinfeld
Primary target markets	Electricity generation, Off-grid energy
Total declared funding to date	$32,000,000
Employees (incl. full time consultants)	28
General approach	Magnetic confinement
Specific approach	Dynamic Stellarator
Fuel source	DT
Planned energy capture approach	Lithium neutron 'blanket'
Pilot plant timescale	2030
Anticipated MWe of first commercial operating facility	10-20 MWe
Milestones in past 12 months	- Built and tested the integrated prototype with fast heating using high power electronics, confinement coils and full range of diagnostic and measuring instruments, with over 2000 full experiments. - Enabling NT-Tao to benchmark the system at lower energies before final assembly of next prototype, which will have higher energy power supplies and stronger performance.

OPENSTAR TECHNOLOGIES

OpenStar is an energy startup pursuing the development of fusion reactors for baseload power to the grid. Building upon the groundbreaking experiments of the levitated dipole pioneered by LDX at MIT and RT-1 at the University of Tokyo, OpenStar embraces the natural stability inherent to the dipole field - creating fusion reactors to power the future.

Location	Wellington, New Zealand (HQ/facility); USA (other operations)
Contact details	info@openstar.nz
Year founded	2021
Founder names	Ratu Mataira-Cole
Primary target markets	Electricity generation
Total declared funding to date	$12,000,000
Employees (incl. full time consultants)	42
General approach	Magnetic confinement
Specific approach	Levitated Dipole
Fuel source	DT
Planned energy capture approach	Lithium neutron 'blanket'
Pilot plant timescale	Early 2030s
Anticipated MWe of your commercial operating facility?	Pilot plant study underway.
Milestones in past 12 months	Fully-integrated system currently undergoing commissioning for plasma experiments.
Key collaborators/partners	Plasma Science and Fusion Center; Robinson Research Institute

PRINCETON FUSION SYSTEMS

PFS is developing compact fusion reactors for modular and portable power systems. The Princeton FRC utilizes a novel configuration of rotating magnetic fields invented at the Princeton Plasma Physics Lab. The PFRC is uniquely dual-use for both terrestrial use and space power and propulsion.

Location	Plainsboro, New Jersey, USA
Contact details	info@princetonfusionsystems.com
Year founded	Princeton Satellite Systems - 1992. dba Princeton Fusion Systems since 2017
Founder names	Michael Paluszek, Marilyn Ham
Primary target markets	Off-grid energy
Total declared funding to date	$3,600,000 (for fusion business area)
Employees (incl. full time consultants)	6
General approach	Magnetic confinement
Specific approach	Field Reversed Configuration
Fuel source	DHe3
Planned energy capture approach	Brayton cycle
Pilot plant timescale	2030
Anticipated MWe of first commercial operating facility	1 MWe

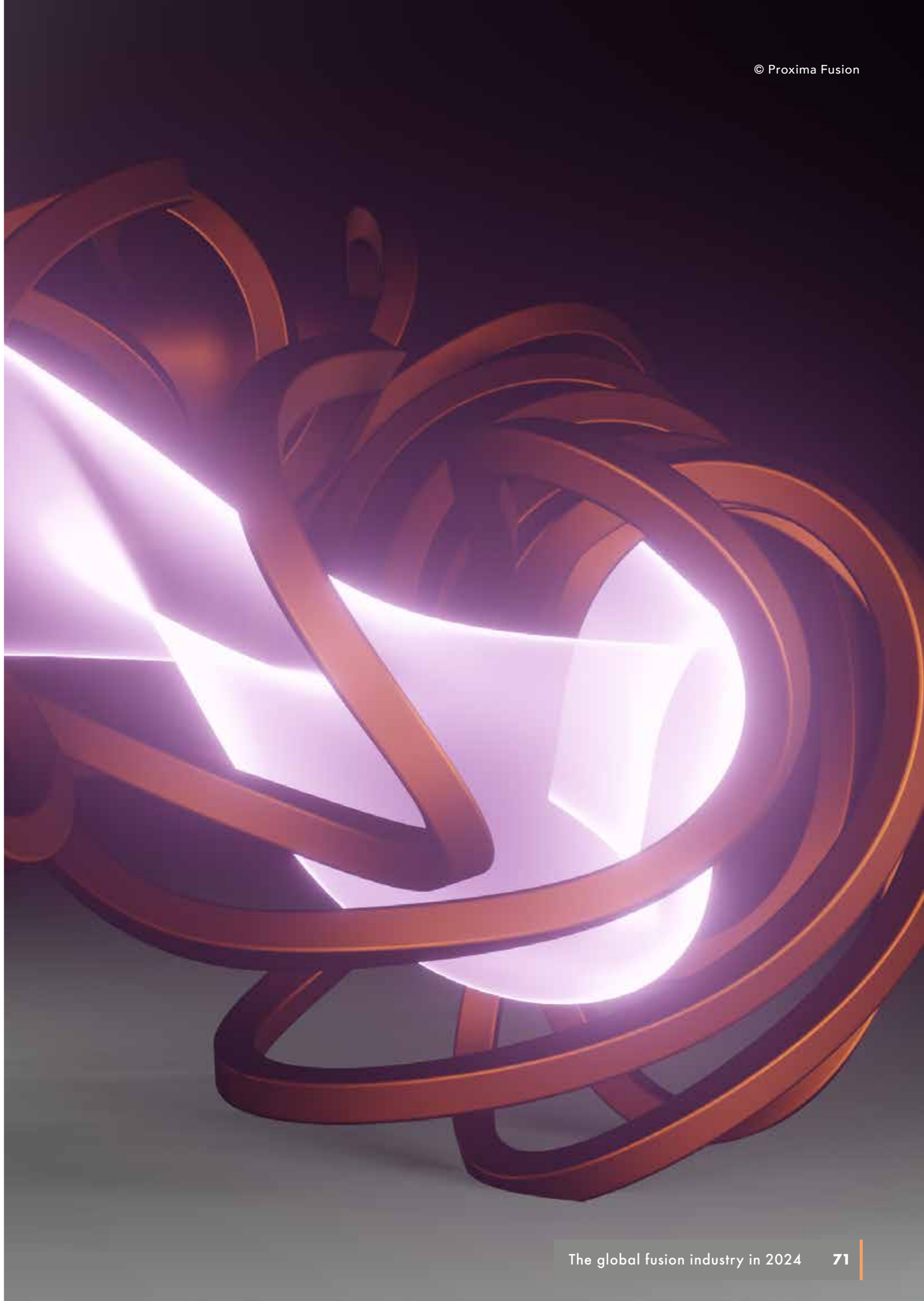
Proxima Fusion

FIA MEMBER

PROXIMA FUSION

Proxima Fusion is building QI stellarators, leveraging experience from W7-X at the Max Planck Institute for Plasma Physics, together with advances in high-temperature superconducting (HTS) technology and computational optimization.

Location	Munich, Germany
Contact details	info@proximafusion.com
Year founded	2023
Founder names	Francesco Sciortino, Lucio Milanese, Jorrit Lion, Jonathan Schilling, Martin Kubie
Primary target markets	Electricity generation, Industrial heat
Total declared funding to date	$40,500,000
Employees (incl. full time consultants)	45
General approach	Magnetic confinement
Specific approach	Quasi-isodynamic stellarator
Fuel source	DT
Planned energy capture approach	Lithium neutron 'blanket'
Pilot plant timescale	2030s
Anticipated MWe of your commercial operating facility?	750MW
Interim plants or facilities planned	Construction of a net-energy stellarator in the early 2030s.
Milestones in past 12 months	- Development of a reactor-relevant stellarator design (with Max Planck partners). - Conceptual engineering design of a stellarator power plant (with Max Planck and KIT partners). - Manufacturing of HTS non-planar magnet prototypes.
Key collaborators/partners	Max Planck Institute for Plasma Physics; Instituto Superior Tecnico Lisbon; Karlsruhe Institute of Technology; Bilfinger Nuclear & Energy Transition; Canadian Nuclear Laboratories; University of Wisconsin; Tuscia University; CERN

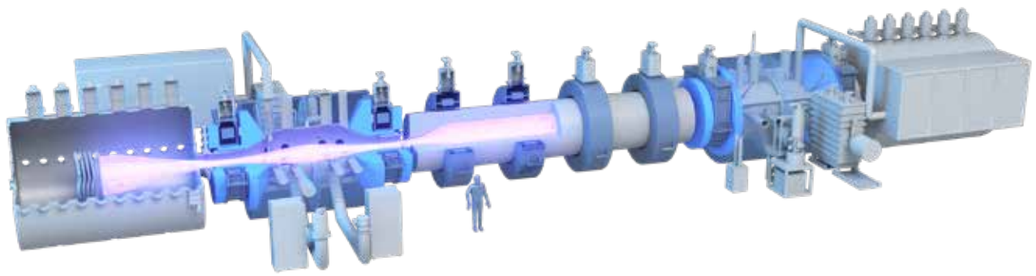


FIA MEMBER

REALTA FUSION

Realta Fusion is developing compact magnetic mirror technology as the lowest capex and least complex path to commercially competitive fusion energy. Realta is targeting the need to decarbonize industrial process heat for early adoption of fusion. The company spun out of an ARPA-e funded project at the University of Wisconsin.

Location	Madison, Wisconsin, USA
Contact details	info@realtafusion.com
Year founded	2022
Founder names	Cary Forest, Kieran Furlong, Jay Anderson, Ben Lindley, Oliver Schmitz
Primary target markets	Off-grid energy, Industrial heat
Total declared funding to date	$13,750,000
Employees (incl. full time consultants)	10
General approach	Magnetic confinement
Specific approach	Magnetic mirror
Fuel source	DT
Planned energy capture approach	Lithium neutron 'blanket'
Pilot plant timescale	10 years
Anticipated MWe of your commercial operating facility?	100 MWe
Interim plants or facilities planned	Anvil - A simple mirror device that demonstrates net energy generating relevant conditions and can be upgraded to a volumetric neutron source.
Milestones in past 12 months	- Realta has developed an integrated model that predicts simple mirror performance and stability and extrapolates these results to tandem mirrors. - This model is being used for Wisconsin HTS Axisymmetric Mirror (WHAM) experimental planning and design of a net-energy producing tandem-mirror endplug, using realistic magnet engineering constraints.
Key collaborators/partners	Department of Energy. Realta Fusion is one of the awardees in the Milestone-Based Fusion Development Program.
Recent published papers	Forest CB, Anderson JK, Endrizzi D, et al. Prospects for a high-field, compact break-even axisymmetric mirror (BEAM) and applications. Journal of Plasma Physics. 2024;90(1):975900101. doi:10.1017/S0022377823001290 Endrizzi D, Anderson JK, Brown M, et al. Physics basis for the Wisconsin HTS Axisymmetric Mirror (WHAM). Journal of Plasma Physics. 2023;89(5):975890501. doi:10.1017/S0022377823000806



© Realta Fusion

RENAISSANCE FUSION

Renaissance Fusion builds on the success of stellarator experiments, makes them reactor ready by quadrupling the magnetic field and simplifies them using proprietary High-Temperature Superconductors manufacturing and flowing liquid-metal walls.

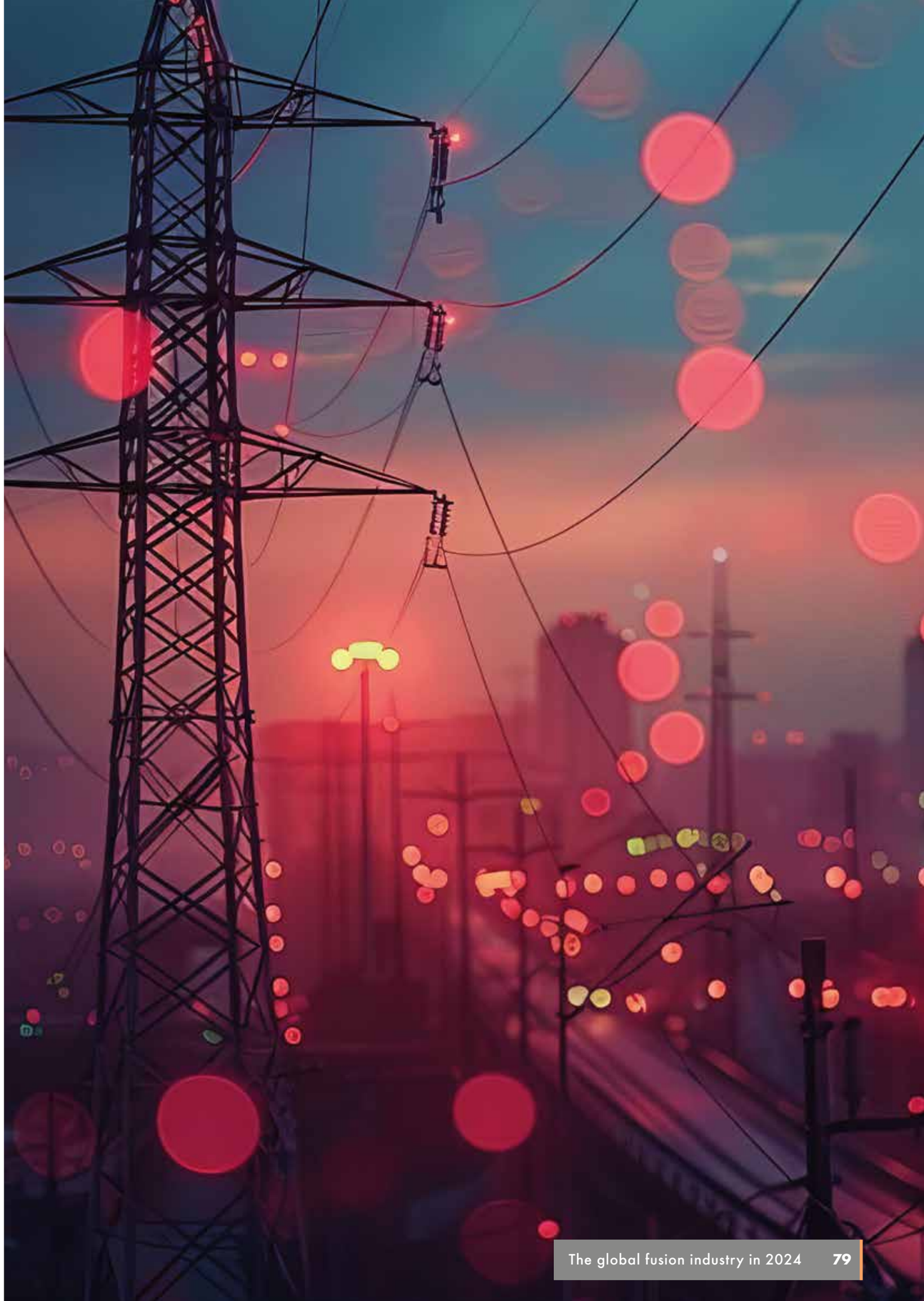
Location	Fontaine, France (HQ); Fontaine, France (Liquid metal lab)
Contact details	contact@renfusion.eu
Year founded	2020
Founder names	Francesco Volpe
Primary target markets	Electricity generation, HTS, Energy storage, Cables, Generators, Big science
Total declared funding to date	$29,500,000
Employees (incl. full time consultants)	61
General approach	Magnetic confinement
Specific approach	Stellarator
Fuel source	DT
Planned energy capture approach	Liquid metal with heat exchanger
Pilot plant timescale	2032
Anticipated MWe of your commercial operating facility?	1000MW
Interim plants or facilities planned	Experimental reactor proving Q greater than 2 and continuous operations
Milestones in past 12 months	10 cm liquid metal blanket, magnetic field accuracy achieved on a MRI and Gyrotron mock-up with our laser patterning technique.
Recent company investments	- Materials for HTS machines & Liquid metal demonstrator. - Various experimental devices.
Key collaborators/partners	BPI France; CEA; CNRS; INRIA; Université de Lorraine; University of Houston; Universita della Tuscia
Recent published papers	Famà, F. R., et al. "An optimized power conversion system for a stellarator-based nuclear fusion power plant." Energy Conversion and Management 276 (2023): 116572. Prost, V., and Volpe, F. A. "Economically optimized design point of high-field stellarator power-plant." Nuclear Fusion 64.2 (2024): 026007.

SHINE TECHNOLOGIES

As today's fusion company, we're commercializing and industrializing near-term applications of fusion – like neutron testing and producing medical isotopes. These applications create social and economic value today, while allowing us to build and practice essential capabilities for deploying fusion energy to billions of people over the long-term.

Location	Janesville, Wisconsin, USA (HQ and main campus); Fitchburg, Wisconsin, USA (Systems and Manufacturing facility and Phoenix Imaging Center); Veendam, Netherlands (SHINE Europe HQ)
Contact details	info@shinefusion.com
Year founded	2005
Founder names	Greg Piefer
Primary target markets	Electricity generation, Medical, Neutron imaging and radiation effects testing for advanced industrial inspection, Transmutation of nuclear waste using fusion neutrons either to stabilize fast reactors or through direct transmutation.
Total declared funding to date	$800,000,000
Employees (incl. full time consultants)	262
General approach	Phase 1: beam-solid target, Phase 2: beam-gas target, Phase 3: beam-plasma target, Phase 4: high temperature plasma Hybrid electrostatic confinement
Fuel source	DT
Planned energy capture approach	Fission-fusion hybrid
Pilot plant timescale	Phase 1 - complete, Phase 2 - 2026, Phase – 2032, Phase 4 - 2040
Anticipated MWe of your commercial operating facility?	Phase 1: 10-1,000W. Phase 2: 1W. Phase 3: 10MW. Phase 4: 100+MW
Interim plants or facilities planned	- The recently launched FLARE (Fusion Linear Accelerator for Radiation Effects) testing service will use high-energy fusion neutrons (14 MeV) for radiation effects testing for defense and aerospace, beating the next best alternative by a factor of ~20. - Cassiopeia, launched in 2024, is the largest production facility for non-carrier-added lutetium-177 (n.c.a. Lu-177) in North America, with a capacity of up to 100,000 patient doses per year. - Chrysalis is nearing completion of construction and will be the home of our fusion-driven medical isotope production and flexible irradiation facility. - Our Phoenix Imaging Center, in Fitchburg, is commercial and uses fusion-based technology to inspect industrial components through neutron imaging, radiation effects testing and other forms on non-destructive testing.
Milestones in past 12 months	- Demonstrated advanced plasma window technology, allowing for high power density (>100 kW /cm2) particle beams to interact with a dense target while minimizing pumping requirements. - Commissioning completed on a commercially operational full-scale tritium-deuterium separation and purification system. - Achieved profitability with Phase 1 neutron radiography business. - Safety Evaluation Report (SER) issued by Nuclear Regulatory - Commission (NRC) for the Chrysalis. - Deployed Cassiopeia isotope production line. - Started commercial production of Yb-176 for medical purposes.
Recent company investments	- Launch of FLARE testing service. - Total investment in CapEx of about $50M.
Key collaborators/partners	Department of Energy National Nuclear Security Administrations; Department of Energy (Office of Science, Fusion Energy Science program); Argonne National Lab; Oak Ridge National Lab Savannah River National Lab; Lawrence Livermore National Lab, National Ignition Facility; Y-12 National Security Complex Orano USA; Department of Energy, ARPA-E; GE-Hitachi; Department of Defense

Recent spin outs/patents/commercial innovations	- Launched state-of-the-art 14 MeV neutron radiation effects testing service (FLARE) to support the strategic defense and space community. - Opened Cassiopeia in 2024 at the Janesville campus. It is the largest production facility for non-carrier-added lutetium-177 (n.c.a. Lu-177) in North America, with a capacity of up to 100,000 patient doses per year. - We received 15 granted patents between May 1, 2023 and May 1, 2024, including 8 in the US and 7 in foreign jurisdictions. - SHINE filed 87 patent applications between May 1, 2023 and May 1, 2024 across a total of 35 patent families. 11 of these patent families were newly generated in this 12-month stretch. This represents a ~35% increase in total SHINE patent applications and granted patents, and a ~30% increase in total SHINE patent families.
Recent published papers	"Plasma Window Performance and Scaling for an Accelerator Based Neutron Source," Review of Scientific Instruments, 94, 11511 "A Plasma-Window Enhanced Accelerator-Based Deuterium-Tritium Neutron Generator System", Fusion Science and Technology "Isotope Recovery from UNF Recycling and Transmutation," Transactions of the 2024 American Nuclear Society Annual Meeting



STARTORUS FUSION

Startorus Fusion is a Chinese startup for fusion energy development located at Xi'an, Shaanxi Province, based on a pulsed spherical tokamak approach.

Location	Xi'an, Shaanxi Province, China
Contact details	business@startorus.cn
Year founded	2021
Founder names	Tan Yi, Chen Rui
Primary target markets	Electricity generation, Off-grid energy
Total funding declared to date	$69,000,000
Employees (incl. full time consultants)	107
General approach	Magnetic confinement
Specific approach	Spherical tokamak
Fuel source	DT
Planned energy capture approach	Lithium neutron 'blanket'
Pilot plant timescale	2028
Anticipated MWe of commercial operating facility	100MW
Interim plants or facilities planned	There will be a 3 T, HTS spherical tokamak with a major radius of 1 m prior to pilot plant.
Milestones in past 12 months	- The first device, SUNIST-2, in collaboration with Tsinghua University, was constructed and achieved its first plasma and quickly improved performance with a plasma current (Ip) of approximately 500 kA, a toroidal magnetic field (Bt) of approximately 0.81 T, an ion temperature (Ti) of approximately 500 eV, and an electron density (ne) of approximately 3x10^19 m^-3. A running scheme involving repetitive reconnection heating of ions was successfully implemented. - Additionally, a small D-shaped high-temperature superconducting (HTS) coil with a maximum magnetic field (Bmax) of up to 18 T was successfully tested.
Recent company investments	- Upgraded the power supply of SUNIST-2. - Installed diagnostics, such as Thomason scattering, ion doppler spectrum. - Several HTS magnets.
Key collaborators/partners	Tsinghua University

STELLAREX, INC.

Stellarex is a fusion energy technology development company and spinout of Princeton University dedicated to the rapid commercialization of fusion energy production by applying the significant advantages of the stellarator approach, numerical optimization, and simplified construction.

Location	Princeton, New Jersey, USA
Contact details	info@stellarex.energy
Year founded	2022
Founder names	Richard Carty, Prof. Amitava Bhattacharjee, Dr. Mike Zarnstorff
Primary target markets	Electricity generation
General approach	Magnetic confinement
Specific approach	Stellarator
Fuel source	DT
Planned energy capture approach	Lithium neutron 'blanket'
Anticipated MWe of first commercial operating facility	250 MWe
Interim plants or facilities planned	Stellarex is focused on the design and construction of an intermediate D-T to reduce risks and demonstrate Q > 1.
Milestones in past 12 months	Validation of simplified stellarator construction approach by Princeton's Plasma Physics Laboratory (PPPL).
Recent company investments	Novel methods of tritium extraction in partnership with Savannah River National Laboratory, USA.
Key collaborators/partners	Princeton University; Savannah River National Lab; Max-Planck Institute for Plasma Physics, Germany; Canadian Nuclear Labs; Kinectrics; Hatch Engineering; The Hidden Symmetries in Fusion Energy Collaboration @ the Simons Foundation; Princeton Plasma Physics Lab; Ontario Power Generation
Recent published papers	Qian, T. M., X. Chu, C. Pagano, D. Patch, M. C. Zarnstorff, B. Berlinger, D. Bishop et al. "Design and construction of the MUSE permanent magnet stellarator." Journal of Plasma Physics 89, no. 5 (2023): 955890502.

TAE TECHNOLOGIES

TAE Technologies (pronounced T-A-E) is developing safe, non-radioactive, cost-effective, commercial fusion energy capable of sustaining the planet for centuries. Through its unique approach to fusion, TAE has developed spinoff applications in life sciences, energy storage, electric mobility and fast charging to create a complete clean energy ecosystem. Multidisciplinary and mission-driven by nature, TAE is leveraging proprietary science and engineering to create a bright future.

Location	Foothill Ranch, California, USA; Irvine, California, USA; Locations in UK, EU and Switzerland
Contact details	press@tae.com; pga@tae.com
Year founded	1998
Founder names	Numerous founders
Primary target markets	Electricity generation
Total declared funding to date	>$1,200,000,000
Employees (incl. full time consultants)	>600
General approach	Magnetic confinement
Specific approach	Field-Reversed Configuration
Fuel source	Pursuing p-B11; TAE configuration can also accommodate other fusion fuel cycles such as D-T, D-He3, and D-D
Planned energy capture approach	Heat capture and conventional thermal cycle and/or future direct energy conversion
Pilot plant timescale	2030s: Da Vinci device, prototype p-B11/fusion power plant
Anticipated MWe of first commercial operating facility	350-500 MWe
Interim plants or facilities planned	Copernicus device will demonstrate the viability of TAE's concept at fusion-relevant conditions by operating with hydrogen fuel at the D-T breakeven operating point. See device timeline: https://tae.com/history
Milestones in past 12 months	- Completed construction of Copernicus facility. - Completed buildout of and began operating ancillary component test beds for Copernicus. - Completed primary design of Copernicus device.
Recent company investments	- Construction of Copernicus infrastructure. - Clinical trial capability for TAE Life Sciences advanced cancer treatments. - TAE Power Solutions test beds for e-mobility, energy storage and advanced power management.
Key collaborators/partners	Argonne National Laboratory; General Atomics; Google; ITER; Lawrence Berkeley National Laboratory; Lawrence Livermore National Laboratory; Los Alamos National Laboratory; Massachusetts Institute of Technology; National Institute for Fusion Science – Japan; Nihon University; Oak Ridge National Laboratory; Occidental Low Carbon Ventures; Princeton Plasma Physics Laboratory; Swarthmore College; University of California – Irvine; University of California – Los Angeles; University of Pisa; University of Rochester; University of Texas at Austin; University of Wisconsin – Madison See complete list: **https://tae.com/collaborators**
Recent spin outs/patents/commercial innovations	- TAE Life Sciences: Targeted cancer treatment leveraging accelerator beams first developed for TAE fusion began human trials. - TAE Power Solutions: Commercializing technologies for battery energy storage systems, e-mobility powertrains, off-grid/micro-grid, fast charging, second life of batteries and more. - >1,500 granted patents to date.
Recent published papers	Physics of Plasmas, August 2023: Potential development and electron energy confinement in an expanding magnetic field divertor geometry Physics of Plasmas, October 2023: Stabilization of the Alfven-ion cyclotron instability through short plasmas: Fully kinetic simulations in a high-beta regime Physics of Plasmas, December 2023: Accelerated kinetic model for global macro stability studies of high-beta fusion reactors See complete list: **https://tae.com/research-library**

© TAE Technologies

TERRA FUSION ENERGY CORPORATION

Terra Fusion Energy Corporation is developing fusion systems to provide carbon free, sustainable electrical and thermal energy with engineering simplicity and high reliability. The company builds on the Centrifugal Mirror Fusion Experiment (CMFX), a superconducting magnetic mirror experiment funded by ARPA-E and led by the University of Maryland, Baltimore County (UMBC).

Location	College Park, Maryland, USA
Contact details	info@tf.energy
Year founded	2024
Founder names	Carlos A. Romero Talamas
Primary target market(s)	Electricity generation, Industrial heat
Total funding declared to date	$15,000
Employees (incl. full time consultants)	2
General approach	Magnetic confinement
Specific approach	Centrifugal Magnetic Mirror
Fuel source	DT
Planned energy capture approach	Lithium neutron 'blanket'
Pilot plant timescale	2032
Anticipated MWe of commercial operating facility	Range of units from 5MWe to 100MWe
Interim plants or facilities planned	CMFX-U, a system to test technology integration, including blankets, fueling systems, and heat removal for steady-state operation with Q > 1 conditions.
Key collaborators/partners	Maryland Energy Innovation Accelerator (MEIA); ARPA-E
Recent spin outs/patents/commercial innovations	Centrifugal Mirror for Power Production, Patent pending.
Recent published papers	MCTrans++: a 0-D model for centrifugal mirrors, J. Plasma Phys. vol. 90, 905900217 (2024). **https://doi.org/10.1017/S0022377824000424**

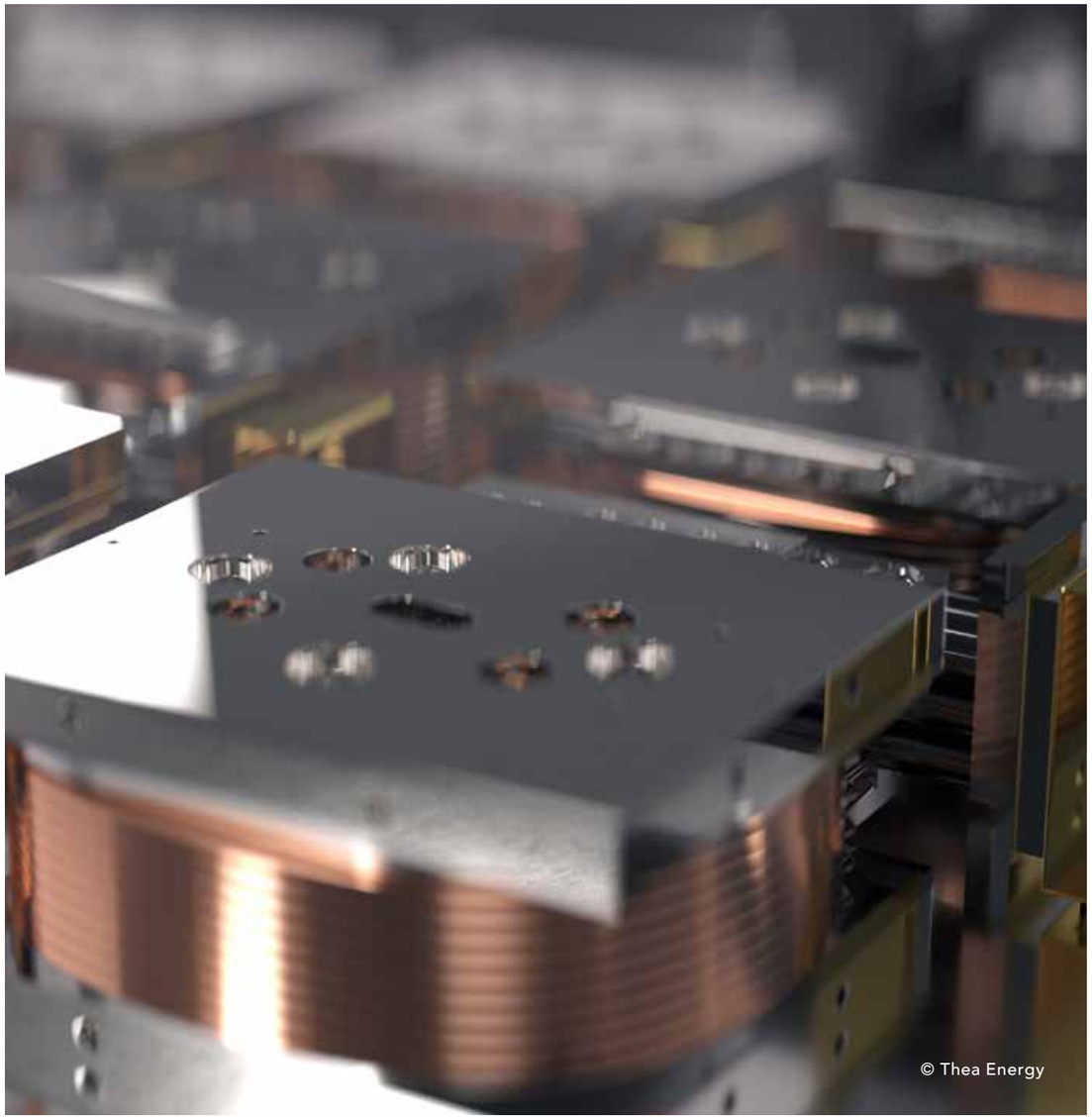
THEA ENERGY

FIA MEMBER

THEA ENERGY

Thea Energy has reinvented the stellarator, enabling systems to be simpler than previously thought possible. The company's proprietary system architecture leverages arrays of planar coils to replace the complex and highly precise modular coils required in prior generations of stellarators, allowing for accelerated deployment of fusion power plants.

Location	Kearny, New Jersey, USA
Contact details	info@thea.energy
Year founded	2022
Founder names	Brian Berzin, David Gates, Matt Miller
Primary target markets	Electricity generation, Tritium and radioisotope production
Total declared funding to date	$23,000,000
Employees (incl. full time consultants)	40
General approach	Magnetic confinement
Specific approach	Stellarator
Fuel source	DT
Planned energy capture approach	Lithium neutron 'blanket'
Pilot plant timescale	Pilot plant in the 2030s.
Anticipated MWe of first commercial operating facility	>200 MWe
Interim plants or facilities planned	Steady-state neutron source stellarator system operation before 2030.
Milestones in past 12 months	- Prototyped multiple generations of HTS planar coil magnets within the past 6 months. - Designed Thea Energy's first array of HTS planar coils, Canis, which will be built and operated over the next 12 months and demonstrate the company's core planar coil stellarator technology and dynamic control system. - Upgraded scalable HTS coil manufacturing processes. - Continued to advance the design of Eos, the company's first integrated stellarator system; established Eos program of record.
Recent company investments	Completed construction and have moved into new company headquarters and labs in Kearny, NJ.
Key collaborators/partners	Numerous collaborations with national labs, academic institutions, and industrial partners including, Kyoto Fusioneering; MagCorp; Max Planck Institute for Plasma Physics; Oak Ridge National Laboratory; Princeton Plasma Physics Laboratory; Stony Brook University; University of California San Diego; and University of Madison-Wisconsin, among others.



Thea Energy's upcoming "Canis" HTS magnet array prototype, which will demonstrate the Company's core planar coil stellarator technology and dynamic control system.

FIA MEMBER

Tokamak Energy

TOKAMAK ENERGY

Tokamak Energy is a global commercial fusion energy company and world leader in two transformative technologies: the compact spherical tokamak and High Temperature Superconductor (HTS) magnets.

Location	Oxford, UK; Bruceton Mills, West Virginia, US
Contact details	media@tokamakenergy.com
Year founded	2009
Founder names	David Kingham, Mikhail Gryaznevich, Alan Sykes
Primary target markets	Electricity generation, Marine propulsion, Off-grid energy, Hydrogen/clean fuels, Industrial heat
Total declared funding to date	$300,000,000
Employees (incl. full time consultants)	260
General approach	Magnetic confinement
Specific approach	Spherical tokamak
Fuel source	DT
Planned energy capture approach	Lithium neutron 'blanket'
Pilot plant timescale	Mid 2030s
Anticipated MWe of first commercial operating facility	500 MWe
Milestones in past 12 months	- Diverted Plasma demonstrated in ST40. - Manufacture and test of 14 toroidal field limbs and two poloidal field coils for Demo4 HTS magnet test facility.
Key collaborators/partners	Furukawa Electric (SuperPower); General Atomics - for HTS magnet scale-up manufacture
Recent spin outs/patents/commercial innovations	Many new applications of HTS magnets identified.

© Tokamak Energy

© Tokamak Energy

TYPE ONE ENERGY GROUP

Type One Energy Group uses stellarator physics and engineering to bring its stellarator fusion power system to international energy markets. The globally-recognized team has a strong track record of building stellarators and applies proven innovations in advanced manufacturing, modern computational physics and high-field superconducting magnets to optimize its stellarator for power production.

Location	Oak Ridge, Tennessee (HQ); Madison, Wisconsin; Boston Massachusetts; Vancouver, British Columbia, Canada
Contact details	information@typeoneenergy.com
Year founded	2019
Founder names	Randall Volberg, David Anderson, John Canik, Paul Harris, Chris Hegna
Primary target markets	Electricity generation, Industrial heat
Total declared funding to date	$30,000,000
Employees (incl. full time consultants)	110
General approach	Magnetic confinement
Specific approach	Stellarator
Fuel source	DT
Planned energy capture approach	Lithium neutron 'blanket'
Pilot plant timescale	2033
Anticipated MWe of first commercial operating facility	500 MWe
Interim plants or facilities planned	Infinity One - small scale stellarator incorporating HTS magnets, advanced optimization, and advanced manufacturing. Staging device prior to building Fusion Power Plant (FPP).
Milestones in past 12 months	- Completed world's first HTS Stellarator Magnet under ARPA-E grant, which met all technical milestones. - More than 20 patent filings.
Recent company investments	- Completed the world's first HTS Stellarator Magnet under ARPA-E grant, which met all technical milestones. - Established magnet lab in new offices near Boston with associated major equipment purchases. - Opened new offices in Oak Ridge, TN and Vancouver, BC Canada, expanded Madison, WI offices.
Key collaborators/partners	Tennessee Valley Authority; MIT; CFS; ORNL; UW-Madison; LBNL; PPPL; UT-Knoxville and others
Recent spin outs/patents/commercial innovations	20 patent filings.

XCIMER ENERGY INC.

Xcimer will combine technologies in a new way, to build the world's largest laser and apply the physics proven by NIF to a commercial energy system.

Location	Denver, Colorado, USA
Contact details	info@xcimer.energy
Year founded	2022
Founder names	Conner Galloway, Alexander Valys
Primary target markets	Electricity generation, defense
Total declared funding to date	$105,000,000
Employees (incl. full time consultants)	50
General approach	Inertial confinement
Specific approach	Laser-driven inertial confinement
Fuel source	DT
Planned energy capture approach	Lithium neutron 'blanket'
Pilot plant timescale	Mid 2030s
Anticipated MWe of first commercial operating facility	300MWe to 2GWe
Interim plants or facilities planned	Xcimer will construct a breakeven facility, where positive engineering gain will be achieved. This facility will support several shots per day, and will not have a fusion blanket.
Milestones in past 12 months	Experimentally confirmed kinetic regime of Stimulated Brillouin Scattering, key to Xcimer's laser technology.
Recent company investments	New facility in Denver where a prototype laser system is being constructed.

FIA MEMBER

ZAP ENERGY

ZAP ENERGY

Zap Energy is building a low-cost, compact and scalable fusion energy platform that confines and compresses plasma, without the need for expensive and complex magnetic coils. Zap's sheared-flow-stabilized Z-pinch technology provides compelling fusion economics and requires orders of magnitude less capital than conventional approaches.

Location	Everett, Washington, USA
Contact details	reachout@zap.energy
Year founded	2017
Founder names	Benj Conway, Brian A. Nelson, Uri Shumlak
Primary target markets	Electricity generation
Total declared funding to date	$208,000,000
Employees (incl. full time consultants)	150
General approach	Magnetic confinement
Specific approach	Z-pinch
Fuel source	DT
Planned energy capture approach	Liquid metal with heat exchanger
Pilot plant timescale	Pilot plant siting feasibility study underway.
Anticipated MWe of commercial operating facility	Each module anticipated to be roughly 50MWe
Interim plants or facilities planned	Century is the first fully integrated demonstration of three major plant-relevant technologies operating at up to 100 kilowatts of input power. It will validate repetitive pulsed power supplies, plasma-facing circulating liquid metal walls, and technology for mitigating electrode damage in an SFS Z-pinch system operating at high average power.
Milestones in past 12 months	- 3 keV plasma electron temperatures coincident with neutron production. - Neutron yields exceeding 5x10^9 per shot. - Second-generation liquid metal loop demonstrated 100 hours of continuous operation of circulating liquid metal over a weir wall under vacuum. - First generation repetitive pulsed power supply achieved 1,000 shots at 0.1 Hz. - Two new next-generation pulsed power banks built and commissioned.
Recent company investments	- Moved into new 100,000 sq. ft. HQ building with expanded testbeds in Everett, Wash. - New space dedicated to pulsed power opened in San Diego, Calif. - Acquired more than 500 tons of manufacturing equipment from ICAR, formerly a leading global manufacturer of capacitors and power supply equipment, based in Italy.
Key collaborators/partners	University of Washington; Lawrence Livermore National Laboratory; Los Alamos National Laboratory; TransAlta
Recent published Papers	[1] Elevated electron temperature coincident with observed fusion reactions in a sheared-flow-stabilized Z pinch, Physical Review Letters (Apr 2024) [2] Whole device modeling of the FuZE sheared-flow-stabilized Z pinch, Nuclear Fusion (Apr 2024) [3] The Zap Energy approach to commercial fusion, Physics of Plasmas (Sept 2023) [4] Electrode durability and sheared-flow-stabilized Z-pinch fusion energy, Physics of Plasmas (Oct 2023) For further publications, see zapenergy.com/research

© Zap Energy

Fusion Industry Association
800 Maine Ave SW
Suite 223
Washington, DC 20024
United States

www.fusionindustryassociation.org

twitter.com/Fusion_Industry
www.linkedin.com/company/fusion-industry-association
www.youtube.com/c/FusionIndustryAssociation
anchor.fm/fusionindustry