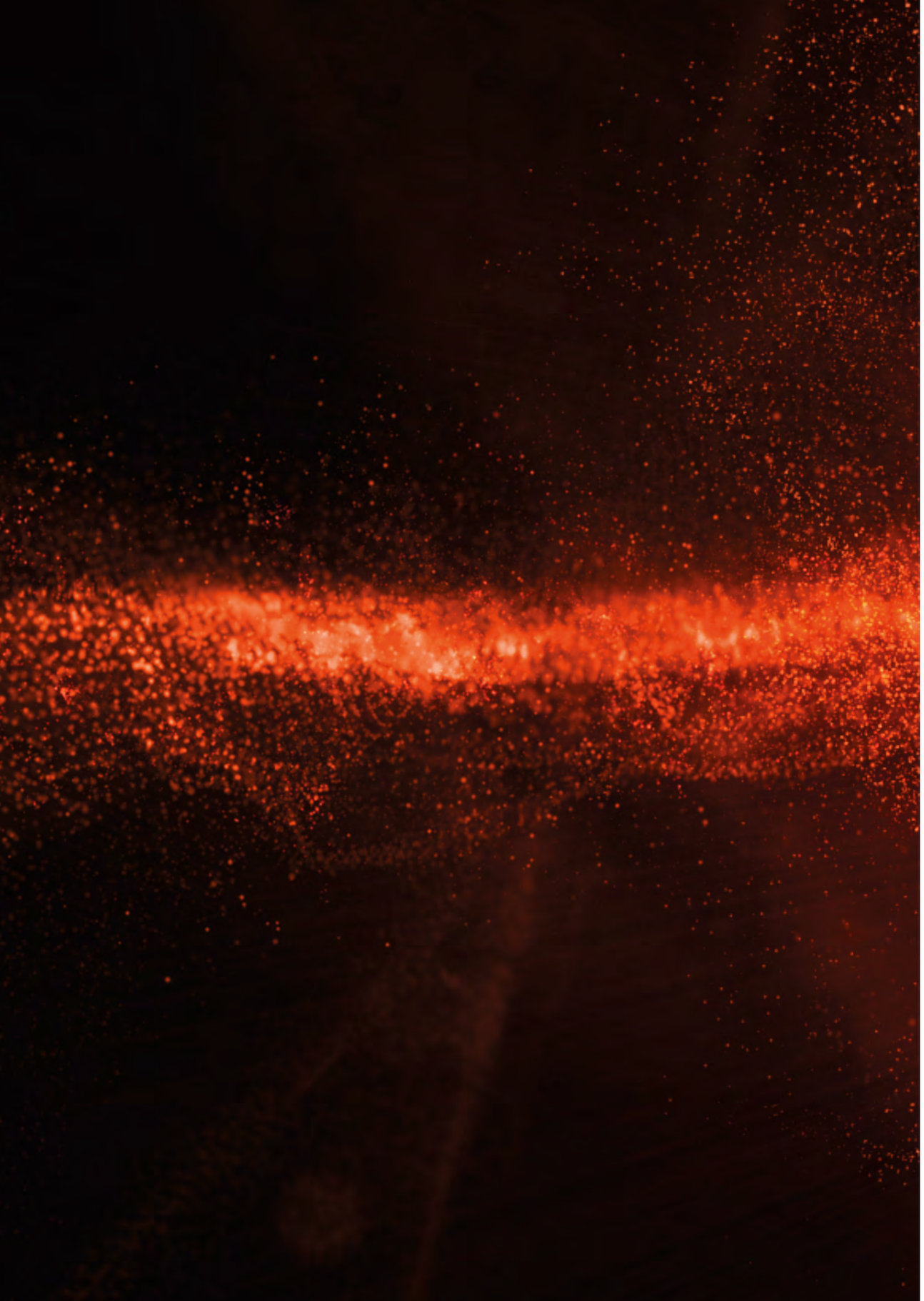
The global fusion industry in 2022

Fusion Companies Survey by the Fusion Industry Association



FOREWORD

Last year, we started our report by saying “It is an exciting time for fusion energy” – and little did we know how transformative the year to come would be. When the history books are written about fusion energy, the last 12 months will be seen as the turning point when it became clear that fusion would move out of the laboratories and into the marketplace.

For just a few examples, we saw a controlled “burning plasma” for the first time at the National Ignition Facility in California, record amounts of energy produced from the Joint European Torus in Oxford, and record lengths of high-temperature plasma confinement at KSTAR in South Korea and at EAST in China. Not to be outdone, privately funded fusion companies in the FIA reached important milestones of their own: Commonwealth Fusion Systems in Massachusetts demonstrated the world’s strongest magnet, while Helion in Washington and Tokamak Energy in the UK each reached milestone plasma temperatures of above 100 million degrees, and General Fusion in Canada proved their ability to precisely compress a plasma.

Now, with those milestones achieved, private investment is coming in, allowing the fusion industry to build the proof-of-concept devices that will show fusion energy can work. As our survey shows, private industry has secured over $2.8 billion in new private investment since our last survey a year ago, bringing total private investment to over $4.7 billion. This funding will allow fusion companies to push toward their “Kitty Hawk moment” in the coming years. From there, companies will rapidly build the pilot plants that will prove fusion energy is ready for the marketplace.

As fusion transitions from the lab to commercialization, private companies need governments to become a real partner in this effort. We must not see a “competition” between publicly funded and privately funded fusion approaches; instead, we must build real partnerships. As the private sector builds the power plants, governments will need to build the infrastructure and train the workforce that enable the fusion energy revolution. In a virtuous cycle, greater investment and partnerships will “crowd in” more private fusion investment and show the value of the way forward.

In March of 2022, I and many FIA members went to the White House for a summit, hosted by the US Department of Energy and the Office of Science and Technology Policy to plan a “Bold Decadal Vision for Commercial Fusion Energy”. The plan, being put together now, is to build, in 10 years, multiple fusion pilot plants of different sizes, approaches, and fuels operating in new fusion technology hubs around the country. This plan will also need funding and political support, but it shows the growing interest in fusion. Importantly as well, to support safe deployment, industry is working with regulators around the world to ensure that fusion energy is safe and appropriately regulated.

Outside of our work on fusion, we’ve seen too many reminders in the last year of why fusion investment is so important. The news about climate change continues to show that countries are not meeting their pledged emissions reductions goals, while impacts like droughts, heat waves and extreme storms get worse.

In the geopolitical realm, Russia's invasion of Ukraine and the unified Western response is partially a story about energy. Putin would not have been able to finance his war machine, nor dared invade Ukraine, had Russia not had vast hydrocarbon deposits. When fusion is widely available, these "energy weapons" will not be nearly as powerful against peaceful nations.

As we respond to these crises of today, fusion investments can help secure the peace for the long term. If we make the required investments now, fusion energy should provide the basis for prosperity, safety, and security.

The state of the global fusion industry in 2022

In this survey, fusion companies declared over $4.7bn of private funding to date, plus an additional $117 million in grants and other funding from governments, more than doubling the industries entire historic investment in a single year. These included notable investments including a massive $1.8bn investment into Commonwealth Fusion Systems, $500m into Helion Energy and several important ones over $100m.

As the charts presented below show, the vast majority of companies are focused primarily on energy generation, however most reported at least two other potential markets for their technologies, with space and marine propulsion being the most common, as well as widespread interest in using fusion energy to produce not just electricity to the grid but as a way to produce hydrogen, clean fuels or off grid energy. Many companies are flexible and pursuing multiple markets.

Expectations remain consistent with last year with the vast majority of companies predicting fusion will first power the grid at some point in the 2030s, although a more detailed breakdown of this question this year shows a leaning towards the first half of the decade.

For all the progress, one area that clearly still needs work is in promoting a more diverse workforce. Self-reporting of data remains patchy, but women and minority groups remain underrepresented in fusion, a problem that exists throughout science and engineering industries. In this year's report, we note a small increase in the percentage of female employees at fusion companies from 21.8% to 23.8%, and we are excited to see new programs like "Women in Fusion" that will increase opportunities in this growing industry. This is important because a diverse workforce both ensures that the benefits of fusion are widely shared and because a workforce that reflects broader society brings real benefits in decision making to the industry.

We would like to thank all the companies involved for talking about their businesses and scientific progress to help us build this picture of the fusion industry. We hope it will become a useful resource for both the fusion community and those outside the fusion sector wishing to know more.

About the Report

This is the second annual "Global Fusion Industry Report" from the Fusion Industry Association.

In this report, we strive to be impartial, presenting the information on the various companies as it has been conveyed to us. All company achievements and data are entirely self-reported. It is not an exhaustive survey. We approached the fusion businesses that we know about and where contact information was available. Their responses were voluntary.

In this second report, we've reached five fusion companies that we did not know about or could not contact when we did the last report, as well as eight companies that have come on the scene in the last year. There are still certainly some companies that we have missed either because we do not yet know about them, or because they declined to participate, though we believe we have captured all those at an advanced stage. This survey should be seen as a snapshot in time; a view of the industry when the survey was conducted in the second quarter of 2022. Repeating the activity year-on-year enables us to see the picture evolving.

Many private fusion companies are members of the Fusion Industry Association, though this is not a requirement for the report, and we strive to treat members and non-members the same. Membership is marked on company pages by an FIA Member badge. Membership of the FIA is simple: it requires companies to have a plan for fusion commercialization, to demonstrate private investment to support their mission, and to pay dues. Companies playing a supportive role in the fusion industry may join as Affiliate Members, but these wider-industry companies are not the subject of this report. We hope to build a "supply chain" report that reflect the status of these companies soon.

About the The Fusion Industry Association (FIA)

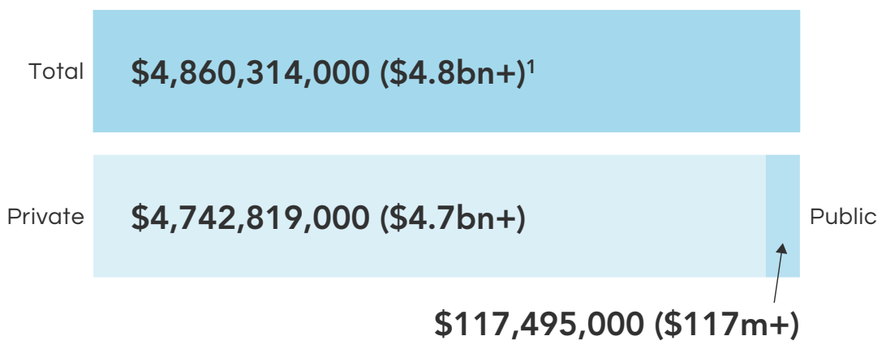
The FIA is the unified voice of the new fusion industry and a central point for coordination across the fusion community to support accelerated growth. The FIA is a registered non-profit organization, headquartered in Washington, DC, composed of private companies working to commercialize fusion power. The Association advocates for policies that would accelerate the race to fusion energy.

The FIA would like to give special thanks to Trinomics and Memetic Communications for their work in pulling together the data and publishing the report.

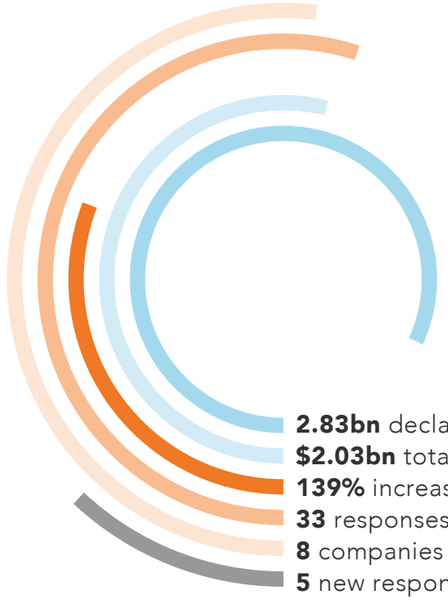
Andrew Holland
Chief Executive Officer
Fusion Industry Association

HIGHLIGHTS TO DATE

1. Funding for fusion companies



2. Change since 2021 survey



2.83bn declared in new funding since last survey
$2.03bn total secured at time of 2021 survey[2]
139% increase in funding since last year's report
33 responses vs 23 in 2021
8 companies founded or emerged from stealth mode
5 new respondents completed the survey (and two dropped out)

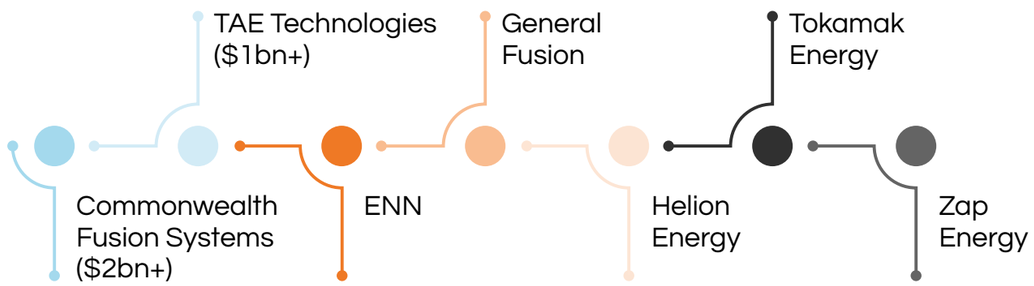
1 Some figures have been rounded. Some funding was declared privately, hence total figure here is higher than combined figures stated in company profiles.
2 The declared in funding in last year's report was $1.87bn. This year's report includes additional survey participants with pre-2021 funding that was not reported last year. This figure is adjusted to include this additional data.

3. Notable investments since the last survey

$1.8bn
Commonwealth Fusion Systems

$500m
Helion Energy

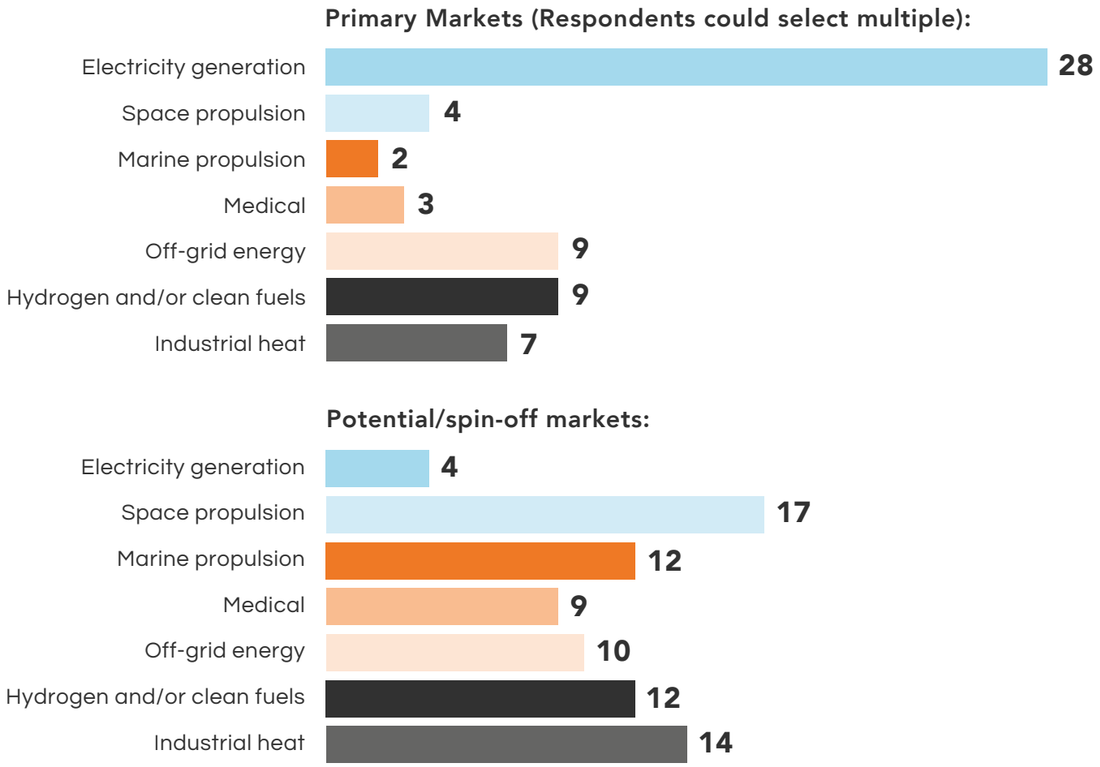
4. Companies with $200m investment or more



5. Location

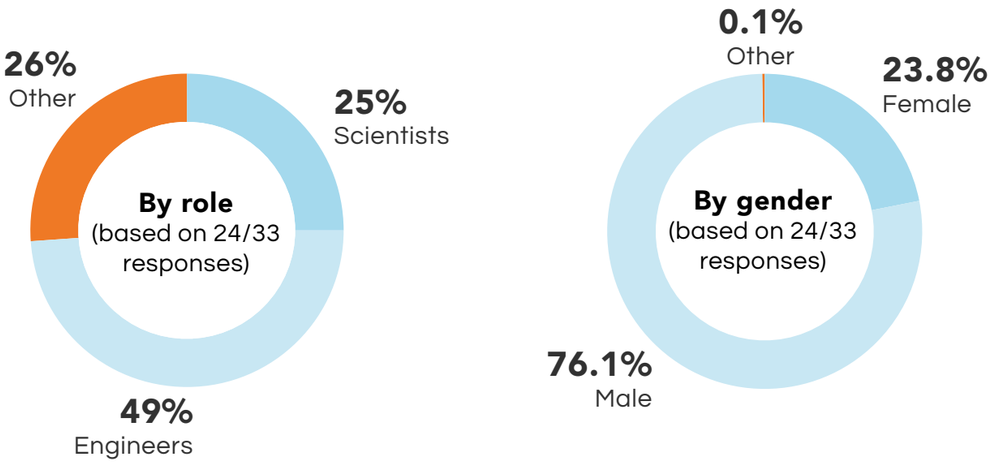
By primary HQ

6. Target markets



7. Employees

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.

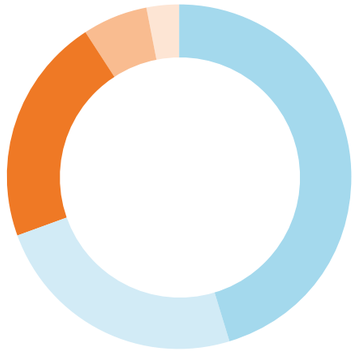


8. Selected* investors in fusion

Addition
Art Samberg
Bezos Expeditions
Bill Gates
Braavos Capital
Braemar Energy Ventures
Breakthrough Energy Ventures
Business Development Bank of Canada (BDC)
Capricorn Investment Group (Jeff Skoll)
Cenovus Energy
Charles Schwab
Chevron Technology Ventures
Chrysalix Venture Capital
Coatue
David Harding (CEO of Winton Group)
DCVC
DFJ Growth
Dr Hans-Peter Wild (Owner of Capri Sun)
Dustin Moskovitz
Emerson Collective
Energy Impact Partners
Eni
Equinor
Fine Structure Ventures
Footprint Coalition
Future Ventures
GA Capital
GIC
Google
Grantham Foundation for the Environment
Hostplus
IP Group
Jameel Investment Management Company (JIMCO)
Jeff Bezos
JIMCO
John Doerr
JS Capital
Kam Ghaffarian
Khazanah Nasional
Khosla Ventures
Kuwait Investment Authority
Legal and General
Lowercarbon Capital
Lukasz Gadowski
Mithril Capital (Peter Thiel)
Moore Strategic Ventures
Oxford Science Enterprises (Oxford Sciences Innovation)
Reid Hoffman
Safar Partners
Sam Altman
Schooner Capital
Segra Capital
Senator Investment Group.
SET Ventures
Shell Ventures
Soros Fund Management LLC
Starlight Ventures
Temasek
Tencent
The Engine
Tiger Global Management
TIME Ventures (Marc Benioff)
Tobias Lütke
Valor Equity Partners
Venrock
Vulcan Capital
Wellcome Trust
Y Combinator

*All of these investors have been publicly identified in previous publications. 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. Approach



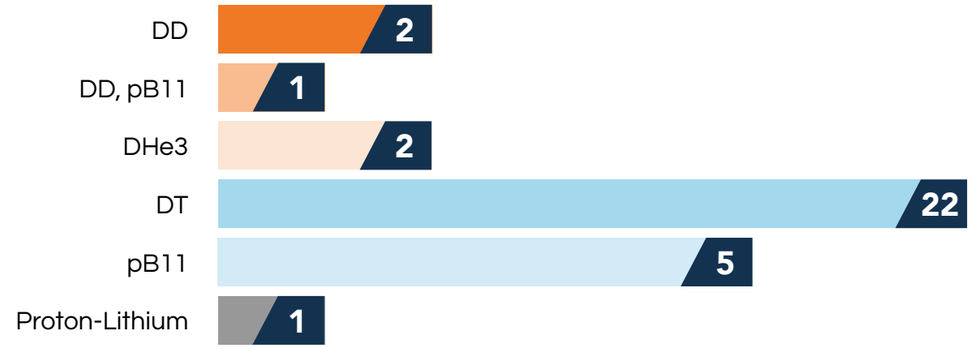
General approach

- **15** Magnetic confinement
- **8** Inertial confinement
- **7** Magneto-intertial
- **2** Electrostatic Hybrid
- **1** Muon-catalyzed fusion

Specific approach

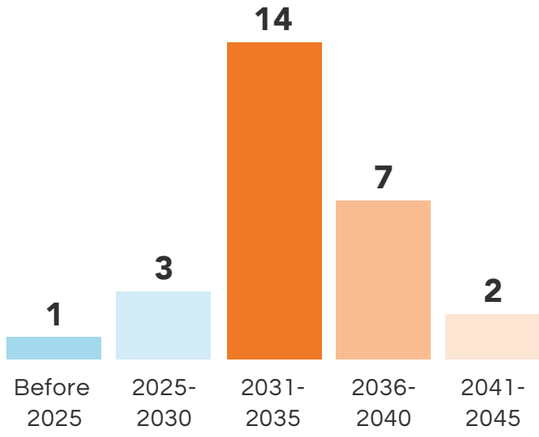
- **4** Field Reversed Configuration
- **4** Stellarator
- **3** Tokamak/Spherical Tokamak
- **2** Z-pinch
- **1** Dense Plasma Focus
- **1** Epicyclotron: a hybrid beam background approach
- **1** Hypervelocity Gradient Field Fusion
- **1** Laser-driven inertial confinement
- **1** Magnetic mirror
- **1** Magnetized target fusion
- **1** Modified Stellarator
- **1** Muon-catalyzed fusion with high density fuel
- **1** Non-thermal laser fusion
- **1** Orbitron (Electrostatic ion orbiting a cathode with magnetron (ExB) electron confinement)
- **1** Oscillating fusion-fizzle cycles with direct EMF extraction
- **1** Plasma Jet driven Magneto Inertial Fusion
- **1** Plectonemic reconnection
- **1** Poloidal magnetic confinement, e.g. Levitron, LDX, Intrap
- **1** Shock-driven inertial confinement
- **1** Spheromak
- **1** Spindle cusp, superconducting shielded-grid

10. Fuel Source

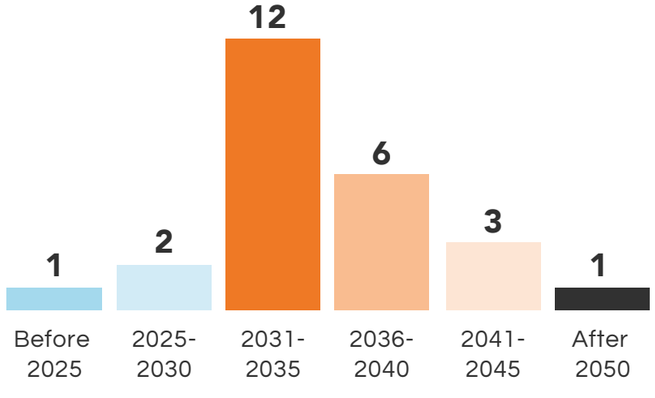


11. Predictions/challenges

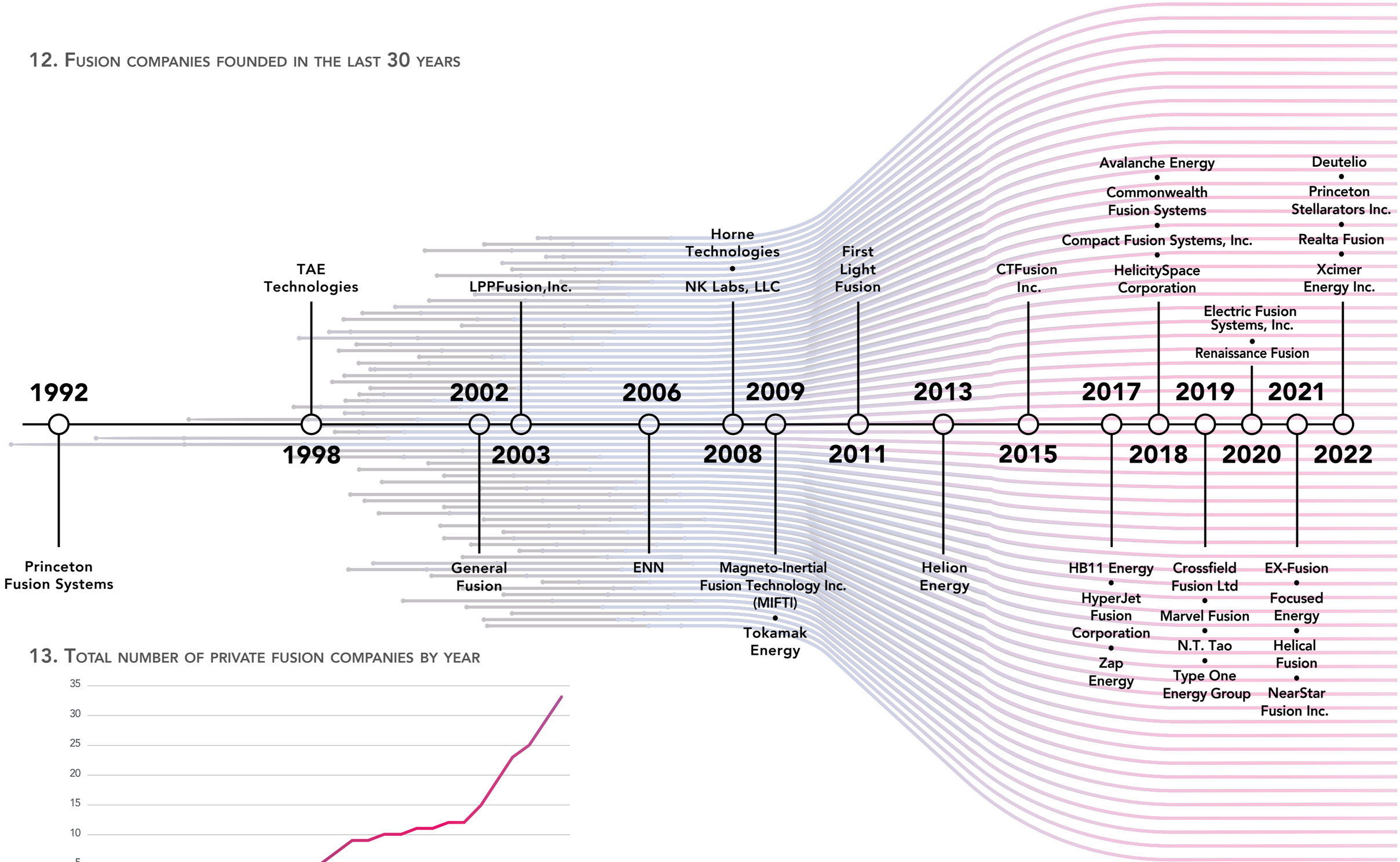
When will the first fusion plant deliver electricity to the grid? (27 responses)



When will the first fusion plant demonstrate a low enough cost/high enough efficiency (Q) to be considered commercially viable? (25 responses)

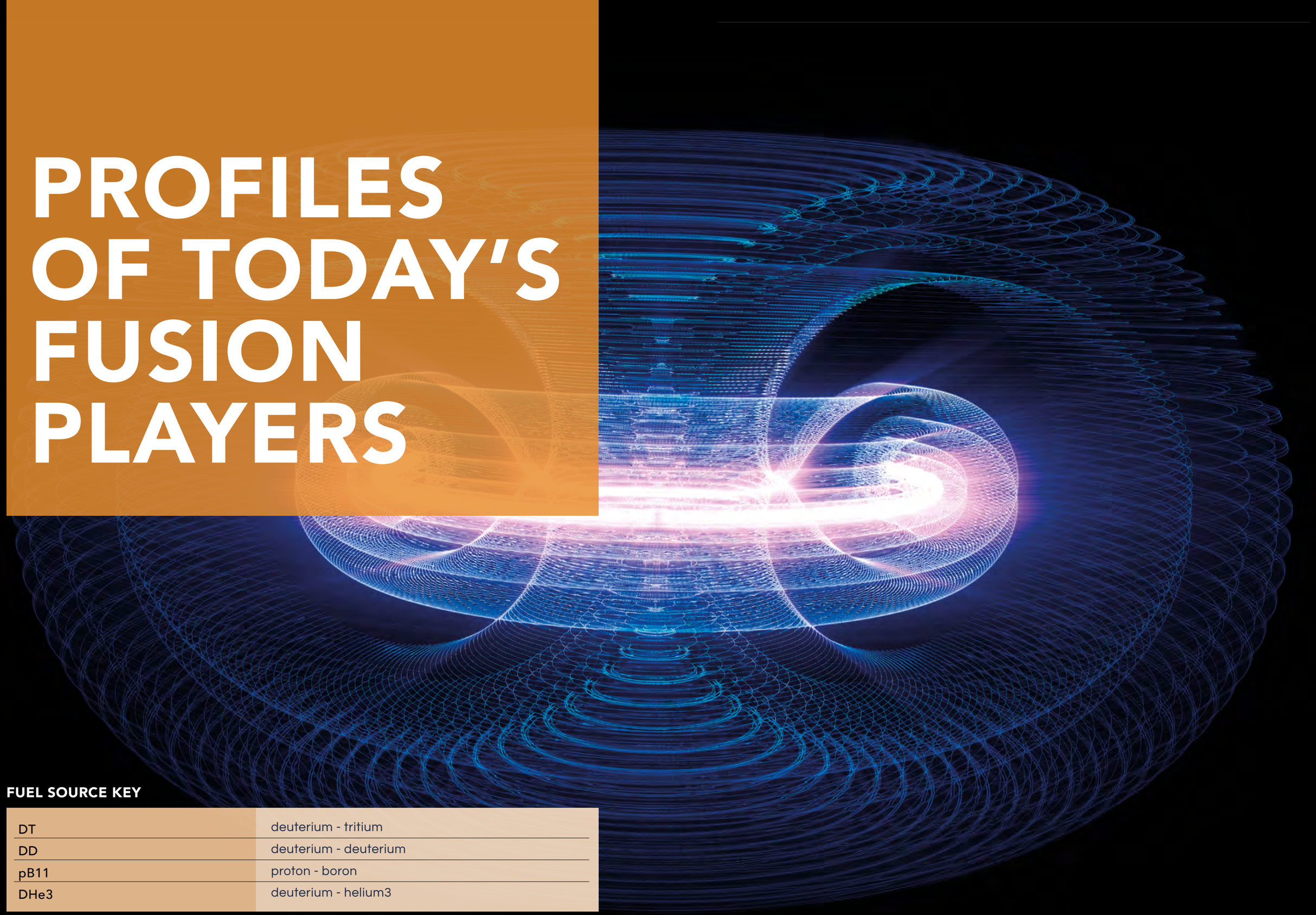


12. Fusion companies founded in the last 30 years



13. Total number of private fusion companies by year

PROFILES OF TODAY'S FUSION PLAYERS



FUEL SOURCE KEY

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

FIA MEMBER

AVALANCHE

AVALANCHE ENERGY

Avalanche Energy is developing a 5kWe fusion power pack called the “Orbitron” in a form-factor the size of a lunch pail. The compact size is a key enabler of scaling for applications including micro-grids, long haul trucking, maritime shipping, aviation and space 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 and power, Marine propulsion, Aviation, Off-grid energy, Hydrogen/synthetic fuels
Total declared funding to date	$5,125,000
Employees (incl. full time consultants)	14
General approach	Hybrid: Inertial electrostatic ion with magnetic electron
Specific approach	Orbitron (Electrostatic ion orbiting a cathode with magnetron (ExB) electron confinement)
Fuel Source	DT
Planned energy capture approach	Lithium neutron ‘blanket’
Milestones in past 12 months	From proof-of-concept simulations to prototype and first fusion neutrons in 9 months.
Pilot plant timescale	Q4/2025 delivery of first prototype to DIU/DoD for qualification testing. Orbital demonstration in 2027.
Anticipated MWe of first commercial operating facility	0.005 MWe
Key collaborators/partners	DoD: Defense Innovation Unit (DIU)
Spin outs/patents/innovations	1st Patent (Sept. 2020)

Commonwealth Fusion Systems

FIA MEMBER

COMMONWEALTH FUSION SYSTEMS

Commonwealth Fusion Systems (CFS) is aiming to develop the fastest, lowest cost path to commercial fusion energy, using high temperature superconductors to build small, low-cost fusion power plants.

Location	Cambridge, Massachusetts, (relocating to Devens, Massachusetts in late 2022), USA
Contact Details	info@cfs.energy
Year founded	2018
Founder Names	Bob Mumgaard, Dan Brunner, Brandon Sorbom, Dennis Whyte, Martin Greenwald, and Zach Hartwig
Primary target markets	Electricity generation
Total declared funding to date	$2,000,000,000+ ($2bn)
Employees (incl. full time consultants)	300+
General approach	Magnetic confinement
Specific approach	Tokamak
Fuel Source	DT
Planned energy capture approach	Lithium neutron 'blanket'
Milestones in past 12 months	**December 2021**: Raised over $1.8 billion in Series B funding, including capital to construct, commission and operate SPARC, the world's first commercially relevant net energy fusion machine. **May 2022**: MIT and CFS expanded research collaboration under a new 5-year agreement. **Construction progress**: nearing completion of construction of high temperature superconducting magnet factory and substantial progress on SPARC building in Devens, MA
Pilot plant timescale	**2025**: SPARC achieves commercially relevant net energy from fusion. **Early 2030s**: First fusion power plant, ARC, completed.
Anticipated MWe of first commercial operating facility	More than 200 MWe

Key collaborators/partners	Partial list includes: Massachusetts Institute of Technology; Brookhaven National Lab; Columbia University; Idaho National Lab; Lawrence Berkeley National Lab; Lawrence Livermore National Lab; Max Planck Institute for Plasma Physics; National Renewable Energy Laboratory; 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.
Recent published Papers	[1] Commercial fusion power: a killer app for HTS, contribution to Superconductors for fusion: a roadmap. Superconductor Science and Technology 34 103001 (2021) [2] Fiber optic quench detection for large-scale HTS magnets demonstrated on VIPER cable during high-fidelity testing at the SULTAN facility. Superconductor Science and Technology 34 035027 (2021) [3] Overview of the SPARC physics basis towards the exploration of burning-plasma regimes in high-field, compact tokamaks. Nucl. Fusion 62 042003 (2022)

COMPACT FUSION SYSTEMS, INC.

Developing a fusion approach based on compression of a field reversed configuration by implosion of a liquid metal cylinder is stabilized by rotation and free-piston drive, avoiding instability and permitting safe reversal after peak compression.

Location	Santa Fe, New Mexico, USA
Contact Details	rmillerzzz@outlook.com
Year founded	2018
Founder Names	Ronald Miller, Peter Turchi, Simon Woodruff
Primary target markets	Electricity generation
General approach	Magneto-intertial
Specific approach	Field Reversed Configuration
Fuel Source	DT
Planned energy capture approach	Liquid metal with heat exchanger
Milestones in past 12 months	conceptual design with advanced fuels
Anticipated MWe of first commercial operating facility	100 MWe

CROSSFIELD FUSION LTD

Crossfield Fusion has been developing a novel compact fusion reactor targeting carbon free heat and power generation. The company adopted a new approach to building fusion reactors based on patented technology called the Epicyclotron.

Location	London, UK
Contact Details	enquires@crossfieldfusion.com
Year founded	2019
Founder Names	Chris Macdonald-Bradley, James Mckenzie
Primary target markets	Electricity generation
Total declared funding to date	$950,000
Employees (incl. full time consultants)	1
General approach	Inertial confinement
Specific approach	Epicyclotron a hybrid beam background approach
Fuel Source	DT
Milestones in past 12 months	In October 2021 the company determined epicyclotron would not scale up, now exploring the use of this technology the developed in hydrogen isotope separation as part of the fusion fuel cycle.
Spin outs/patents/innovations	Hydrogen isotope separation as part of the fusion fuel cycle

CTFUSION, INC.

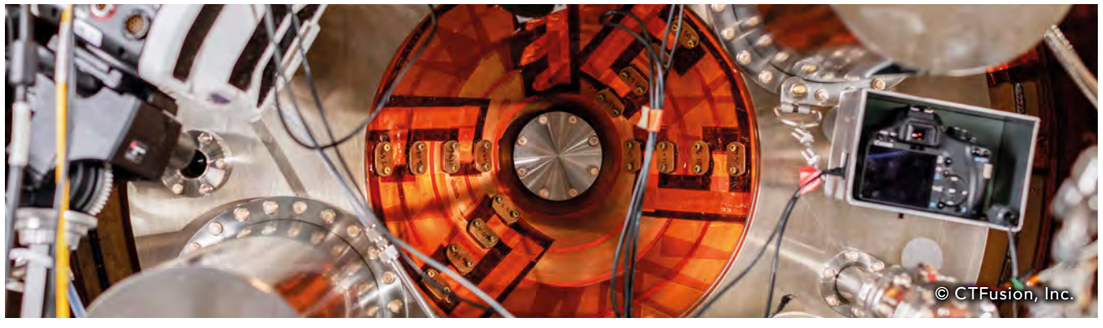
CTFusion is developing the Dynomak approach to magnetic fusion energy that uses spheromak magnetic confinement and imposed-dynamo current drive (IDCD). It aims to enable commercially viable fusion energy for the generation of heat and electricity.

Location	Seattle, Washington, USA
Contact Details	admin@ctfusion.net
Year founded	2015
Founder Names	Derek Sutherland, Chris Ajemian, Scott Brennan, Kyle Morgan, and Aaron Hossack
Primary target markets	Electricity generation
Total declared funding to date	$23,000,000
Employees (incl. full time consultants)	10
General approach	Magnetic confinement
Specific approach	Spheromak
Fuel Source	DT
Planned energy capture approach	Lithium neutron 'blanket'
Milestones in past 12 months	Demonstrated reactor-relevant power injection with P > 20 MW, toroidal currents Ip > 100 kA, and injector voltages V > 700 V. Demonstration formation and sustainment of spheromaks with a helicity injection manifold for the first time, de-risking the design point for the next scaled-up prototype.
Pilot plant timescale	Early 2030s
Anticipated MWe of first commercial operating facility	75-125 MWe
Key collaborators/partners	U.S. DOE (ARPA-E), U.S. DOE Office of Fusion Energy Science (OFES), University of Washington-Seattle, and commercial players we are not at liberty to disclose quite yet.
Recent published Papers	[1] High-speed feedback control of an oscillating magnetic helicity injector using a graphics processing unit, AIP Review of Scientific Instruments ***https://doi.org/10.1063/5.0044805*** [2] Driven resonant current amplification in self-organized plasma configurations with uniform λ and plasma pressure confinement, AIP Physics of Plasmas ***https://doi.org/10.1063/5.0025959*** [3] Effect of injected flux and current temporal phasing on self-organization in the HIT-SI3 experiment, AIP Physics of Plasmas, ***https://doi.org/10.1063/5.0090665***

DEUTELIO

Deutelio aims to achieve nuclear fusion by magnetic confinement with the Polomac configuration using the deuterium-deuterium reaction. It hopes to build a small prototype to validate the concept within three years, designing the first nuclear reactor in five years and achieving electricity in ten years.

Location	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	$534,500
Employees (incl. full time consultants)	2
General approach	Magnetic confinement
Specific approach	Poloidal magnetic confinement with shielded supports of the coil trapped inside the palsma, e.g. Levitron, LDX, Intrap
Fuel Source	DD
Planned energy capture approach	Liquid metal with heat exchanger
Milestones in past 12 months	Technical discussion with EU key scientists in magnetic fusion research Detailed design of a small prototype working with 0.15 m3 of H at 0,25 T expected to reach 1 KeV . It is envisaged to tune the magnetic tunnels and confirm their efficiency.
Pilot plant timescale	**2027**: first nuclear D-D pilot power plant 10 MW for heat production. **2028**: sales for district heating, food industry, agriculture green houses and pools. **2032**: upgrade for electricity generation.
Anticipated MWe of first commercial operating facility	30 MWe

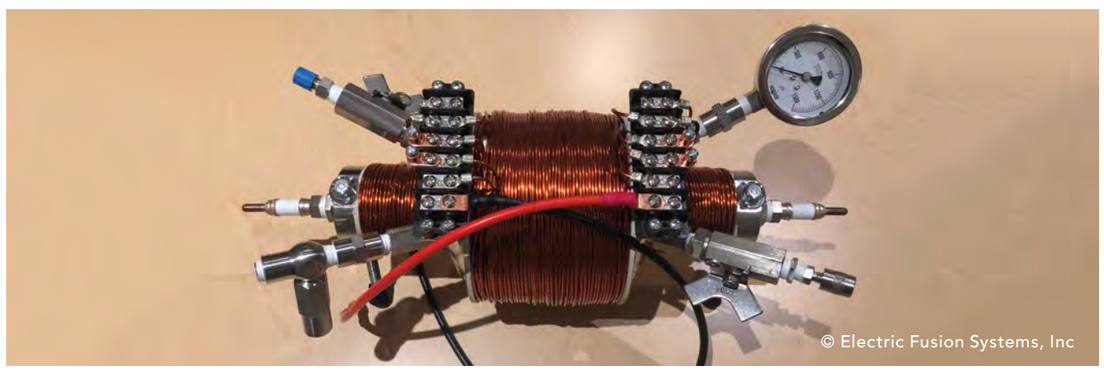

© CTFusion, Inc.

ELECTRIC FUSION SYSTEMS

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. We use a supercritical dense liquid metal fuel 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 and Ryan S. Wood
Primary target markets	Electricity generation, Space propulsion, Off-grid energy, Small portable transportation 1-50 kW
Total declared funding to date	$350,000
Employees (incl. full time consultants)	5
General approach	Pulsed high density aneutronic fusion
Specific approach	Oscillating fusion-fizzle cycles with direct EMF extraction
Fuel Source	Proton-Lithium
Planned energy capture approach	Direct electricity (energy) capture and conversion
Milestones in past 12 months	May 2021 Demonstrated laboratory fusion by creating helium. Nov 2021 Patents filed. Dec 2021 3rd party nuclear simulations. April 2022 Three sets of prototypes designs in testing.
Pilot plant timescale	2023
Anticipated MWe of first commercial operating facility	10 kilowatts to 10 megawatts in depending on number of cartridges and modules.
Key collaborators/partners	Voss Scientific
Spin outs/patents/innovations	Aneutronic Fusion Plasma Reactor and Electric Power Generator (Published May 2022)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ENN新奥

ENN

In 2018, the ENN Fusion Technology R&D Center was established with an aim to deliver clean commercial fusion electricity and heat to customers and radically improve its energy supply network. It is part of the ENN Science and Technology Development Co., Ltd, which is dedicated to addressing humanity's energy challenges in a sustainable, reliable and economic manner.

Location	Langfang, China
Contact Details	qixudong@enn.cn; +86-316-2597072
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, Industrial heat
Total declared funding to date	$200,000,000
Employees (incl. full time consultants)	90 (2021 figures)
General approach	Magnetic confinement
Specific approach	Spherical tokamak
Fuel Source	pB11
Pilot plant timescale	15 years
Key collaborators/partners	Peking University, University of Tokyo, Southwestern Institute of Physics
Recent published Papers	[1] Four-Fluid Axisymmetric Plasma Equilibrium Model Including Relativistic Electrons and Computational Method and Results, Phys. Plasmas 28, 032503, 2021; ***https://doi.org/10.1063/5.0027718*** [2]A Study of the Requirements of p-11B Fusion Reactor by Tokamak System Code, Fusion Science and Technology, 2022; ***https://doi.org/10.1080/15361055.2021.1964309*** [3] BORAY: A ray tracing code for various magnetized plasma configurations, Computer Physics Communications, 2022; ***https://doi.org/10.1016/j.cpc.2022.108363*** [4] Experimental study of the characteristics of energetic electrons outside LCFS in EXL-50 spherical torus, Plasma Physics and Controlled Fusion, 2022; ***https://doi.org/10.1088/1361-6587/ac5a08***

EX-Fusion

FIA MEMBER

EX-FUSION

EX-Fusion aims to build and power the first laser-powered commercial nuclear fusion reactor.

Location	Osaka, Japan
Contact Details	kazuki_matsuo@ex-fusion.com
Year founded	2021
Founder Names	Kazuki Matsuo, Yoshitaka Mori, Shinsuke Fujioka
Primary target markets	Electricity generation, Off-grid energy, Hydrogen/ clean fuels
Total declared funding to date	$1,100,000
Employees (incl. full time consultants)	8
General approach	Inertial confinement
Specific approach	Laser-driven inertial confinement
Fuel Source	DT
Planned energy capture approach	Lithium neutron 'blanket'
Pilot plant timescale	Late 2030s
Recent published Papers	[1] Ten-Hz beads pellet injection and laser engagement, Nucl. Fusion., 62, 036028 2022; ***https://doi.org/10.1088/1741-4326/ac3d69*** [2] Enhancement of ablative Rayleigh-Taylor instability growth by thermal conduction suppression in a magnetic field, Phys. Rev. Lett., 127, 165001, 2021; ***https://link.aps.org/doi/10.1103/*** PhysRevLett.127.165001 [3] Petapascal Pressure Driven by Fast Isochoric Heating with Multi-Picosecond Intense Laser Pulse, Phys. Rev. Lett., 124, 035001, 2020; ***https://doi.org/10.1103/PhysRevLett.124.035001***

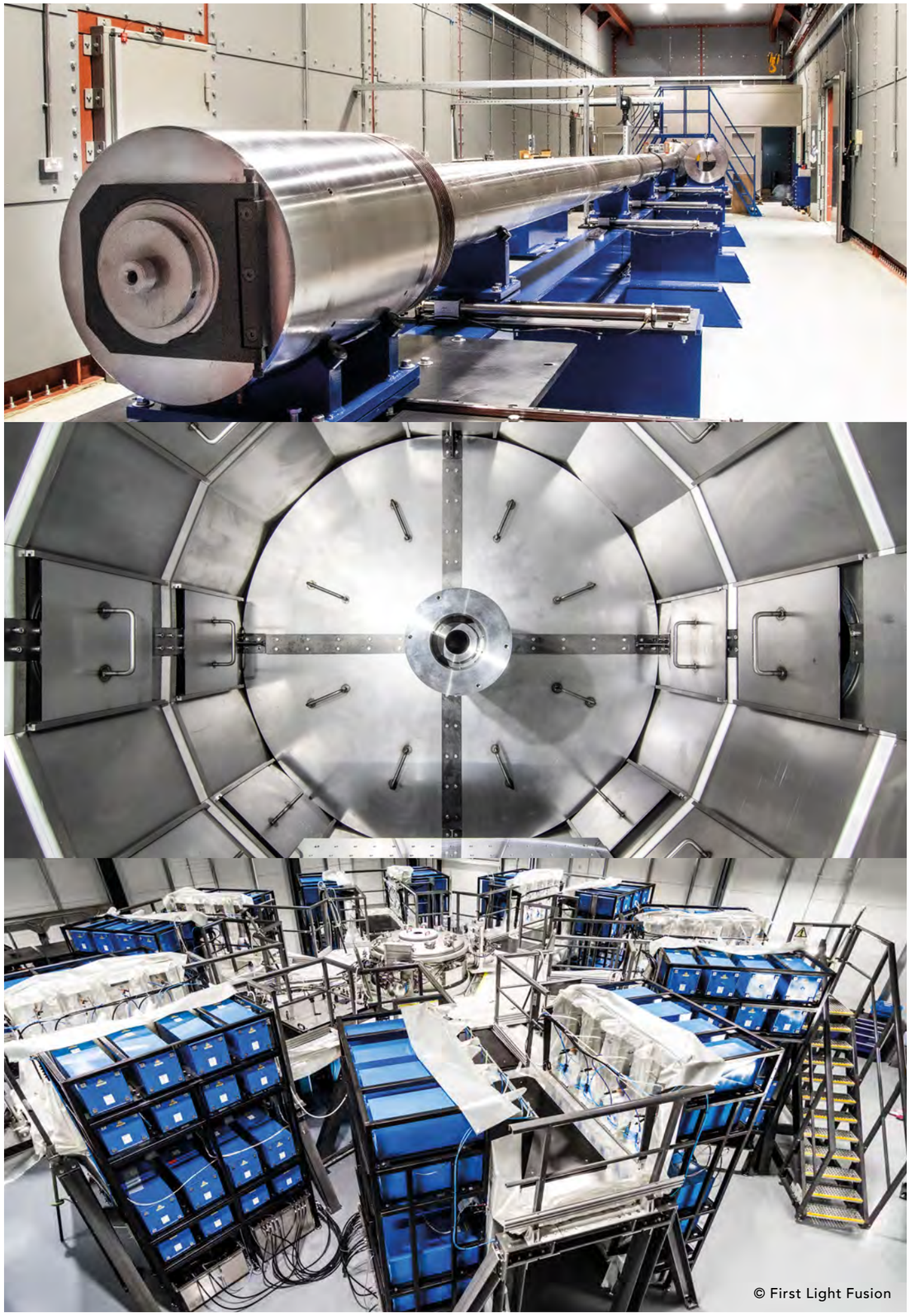
first light

FIA MEMBER

FIRST LIGHT FUSION

Inspired by the only natural example of inertial confinement on Earth, First Light Fusion is developing a practical pathway to fusion energy using the simplest machine possible.

Location	Oxfordshire, 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	$97,813,500
Employees (incl. full time consultants)	70
General approach	Inertial confinement
Specific approach	Shock-driven inertial confinement
Fuel Source	DT
Planned energy capture approach	Liquid metal with heat exchanger
Milestones in past 12 months	First Light Fusion announced the achievement of fusion, proving their unique target technology, in April 2022. The result has been independently validated by the UK Atomic Energy Authority (UKAEA).
Anticipated MWe of first commercial operating facility	150 MWe
Recent published Papers	A preliminary assessment of the sensitivity of uniaxially driven fusion targets to flux-limited thermal conduction modeling
Key collaborators/partners	IDOM, UKAEA



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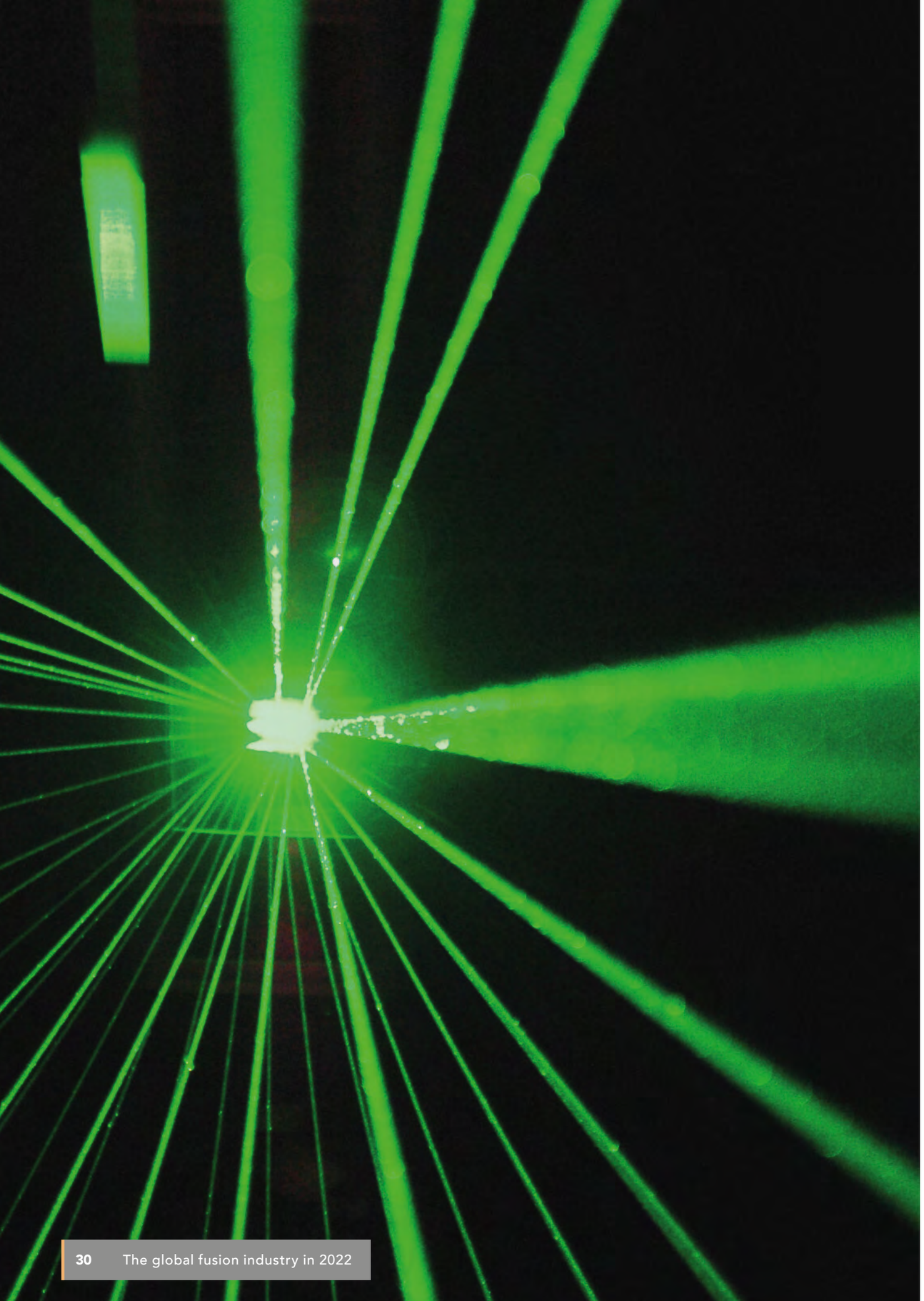


FOCUSED ENERGY

FIA MEMBER

FOCUSED ENERGY

Focused Energy is a US/German startup. The company aims to use the best talent on both sides of the Atlantic to develop fusion as a clean energy source based on laser technology.

Location	Austin Texas, USA Darmstadt, Germany
Contact Details	info@focused-energy.world
Year founded	2021
Founder Names	Todd Ditmire, Thomas Forner, Markus Roth, Anika Stein
Primary target markets	Electricity generation
Total declared funding to date	$15,000,000
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'
Milestones in past 12 months	Plasma physics and target simulations. Technical maturation. Conceptual designs. Feasibility studies. Diagnostics. Supply chain development. Hiring the top scientists and engineers for Austin and Darmstadt offices.
Pilot plant timescale	2035
Anticipated MWe of first commercial operating facility	800 MWe
Key collaborators/partners	Department of Energy, University of Texas, Technische Universität Darmstadt, Laboratory for Laser Energetics Rochester/NY, Extreme Light Infrastructure Prague
Spin outs/patents/innovations	Laser Driven Radiation Source, novel ion beam detector
Recent published Papers	[1] Fast Ignition by intense laser-accelerated proton beams, Phys. Rev. Lett. 3, Vol. 86, p. 436 (2001) [2] Review on the current status and prospects of fast ignition in fusion targets driven by intense, laser generated proton beams Plasma Phys. Contr. Fus. 51 014004 (2009) [3] Transport of an intense proton beam from a cone-structured target through plastic foam with unique proton source modelling Physical Review E 105, 055206 (2022)

generalfusion

FIA MEMBER

GENERAL FUSION

General Fusion pursues a fast, efficient, and collaborative path to practical fusion power. The company is completing an aggressive development plan to deliver economical carbon-free fusion energy with its proprietary Magnetized Target Fusion technology by the early 2030s.

Locations	Vancouver, Canada London, U.K. Oak Ridge, Tennessee, U.S.A.
Contact Details	info@generalfusion.com
Year founded	2002
Founder Names	Michel Laberge
Primary target markets	Electricity generation
Total declared funding to date	$300 million+
Employees (incl. full time consultants)	207
General approach	Magneto-inertial
Specific approach	Magnetized Target Fusion
Fuel Source	DT
Planned energy capture approach	Liquid metal with heat exchanger
Milestones in past 12 months	- Successfully demonstrated key elements of proprietary plasma compression technology - Began site preparations for Fusion Demonstration Plant at the UKAEA Culham Centre for Fusion Energy - Opened new headquarters for new demonstration prototypes and plan to quadruple workforce over the next few years - Closed oversubscribed $130M financing - Formed Market Development Advisory Committee to guide commercial fusion power plant development
Pilot plant timescale	**Underway**: Fusion Demonstration Plant at UKAEA's Culham Centre for Fusion Energy **Early 2030s**: First commercial fusion power plant completed
Anticipated MWe of first commercial operating facility	Approx. 230 MWe from two machines operating in tandem
Key collaborators/partners	**Selected partners and suppliers**: AL_A, ARUP, Canadian Nuclear Laboratories, Hatch Ltd, McGill University, Oak Ridge National Laboratory, Princeton Plasma Physics Laboratory, Sheffield Forgemasters, Turner & Townsend, UKAEA Culham Centre for Fusion Energy, University of Illinois **Market Development Advisory Committee**: ACEN, Bruce Power, Duke Energy, Eneco, E.ON UK, Southern Company, Tennessee Valley Authority, H2 Green Steel, Renexia
Spin outs/patents/innovations	150 patents and patents pending

HB11 ENERGY

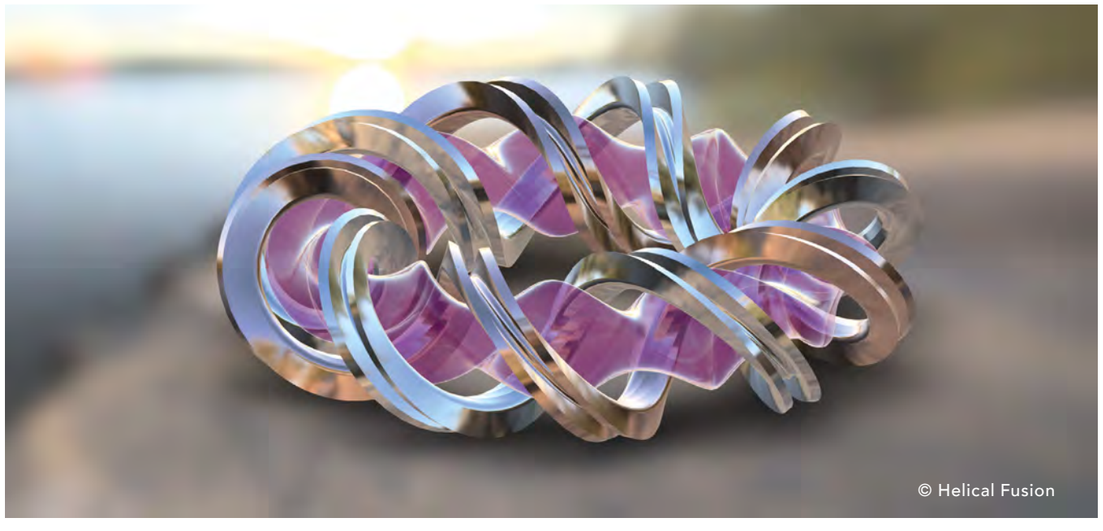
HB11 Energy aims to create a new source of clean, safe and reliable energy using laser technology to fuse Hydrogen and Boron-11.

Location	Sydney, Australia
Contact Details	contact@hb11.energy
Year founded	2017
Founder Names	Heinrich Hora, Warren McKenzie, Jan Kirchhoff, Lukasz Gadowski
Primary target markets	Electricity generation, Hydrogen/clean fuels, Industrial heat
Total declared funding to date	$4,000,000
Employees (incl. full time consultants)	5
General approach	Inertial confinement
Specific approach	Non-thermal laser fusion
Fuel Source	pB11
Planned energy capture approach	Direct energy conversion
Milestones in past 12 months	Several Experiments in the Pipeline, Progress on code development for pB11 Fuel interaction, Part of two different Australian Trailblazer Universities Programs
Pilot plant timescale	2030s
Anticipated MWe of first commercial operating facility	300-500 MWe
Key collaborators/partners	The University of Adelaide, Deakin University, University of Bordeaux, Voss Scientific, Woodruff Scientific
Recent published Papers	***https://www.mdpi.com/2076-3417/12/3/1444/htm***

HELICAL FUSION

Helical Fusion aims to realize the world's first fusion reactor with the helical (heliotron) magnetic configuration.

Location	Tokyo, Japan
Contact Details	contact@helicalfusion.com
Year founded	2021
Founder Names	Junichi Miyazawa, Takaya Taguchi, Nagato Yanagi, Takuya Goto
Primary target markets	Electricity generation, Hydrogen/clean fuels, Industrial heat
Total declared funding to date	$550,000
Employees (incl. full time consultants)	5
General approach	Magnetic confinement
Specific approach	Stellarator
Fuel Source	DT
Planned energy capture approach	Lithium neutron 'blanket'
Milestones in past 12 months	Establishment of the company.
Pilot plant timescale	Early 2040's (pilot plant proving commercial viability)
Anticipated MWe of first commercial operating facility	100 MWe
Key collaborators/partners	National Institute for Fusion Science
Spin outs/patents/innovations	High-temperature superconducting magnet, liquid metal application



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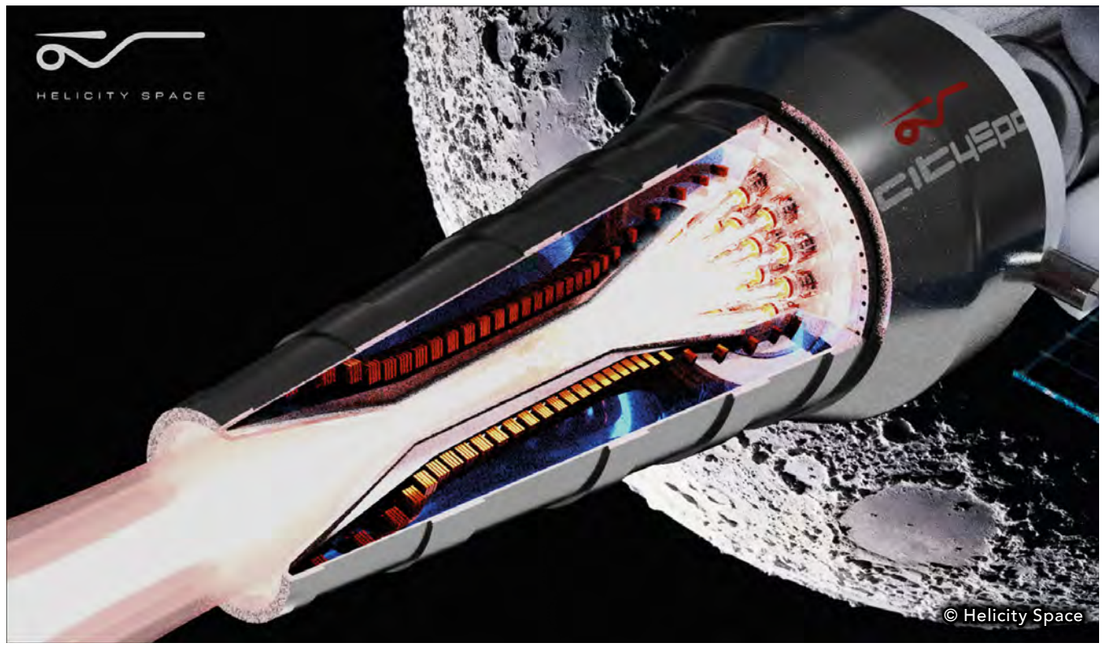
HELICITY SPACE

FIA MEMBER

HELICITYSPACE CORP.

HelicitySpace Corp. develops in-space fusion propulsion engines for deep space travel.

Location	Pasadena, California, USA
Contact Details	info@helicityspace.com
Year founded	2018
Founder Names	Dr. Setthivoine You, Dr. Stephane Lintner, Marta Calvo
Primary target markets	Space propulsion
Total declared funding to date	$6,000,000
Employees (incl. full time consultants)	5
General approach	Magneto-intertial
Specific approach	Plectonemic reconnection
Fuel Source	DD
Planned energy capture approach	Thrust
Milestones in past 12 months	Prototype assembly
Pilot plant timescale	Protoflight in 2032
Key collaborators/partners	Los Alamos National Laboratory, Caltech, UMBC, DOE, Limitless Space Institute



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HELION

FIA MEMBER

HELION ENERGY

Helion Energy, Inc. is developing a pulsed non-ignition fusion technology to produce fusion power using deuterium and helium-3.

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	$577,000,000
Employees (incl. full time consultants)	90
General approach	Magneto-intertial
Specific approach	Field Reversed Configuration
Fuel Source	DHe3
Planned energy capture approach	Direct energy conversion
Milestones in past 12 months	- Announced reaching 9 keV in Trenta, Helion's 6th fusion prototype - Raised $500 million (sufficient to reach commercialization) - Moved to new headquarters in Everett, WA - Completed construction of the facility to house Helion's 7th fusion prototype, Polaris
Pilot plant timescale	Polaris net electricity demonstration – 2024 Pilot plant – end of decade
Anticipated MWe of first commercial operating facility	50 MWe per generator


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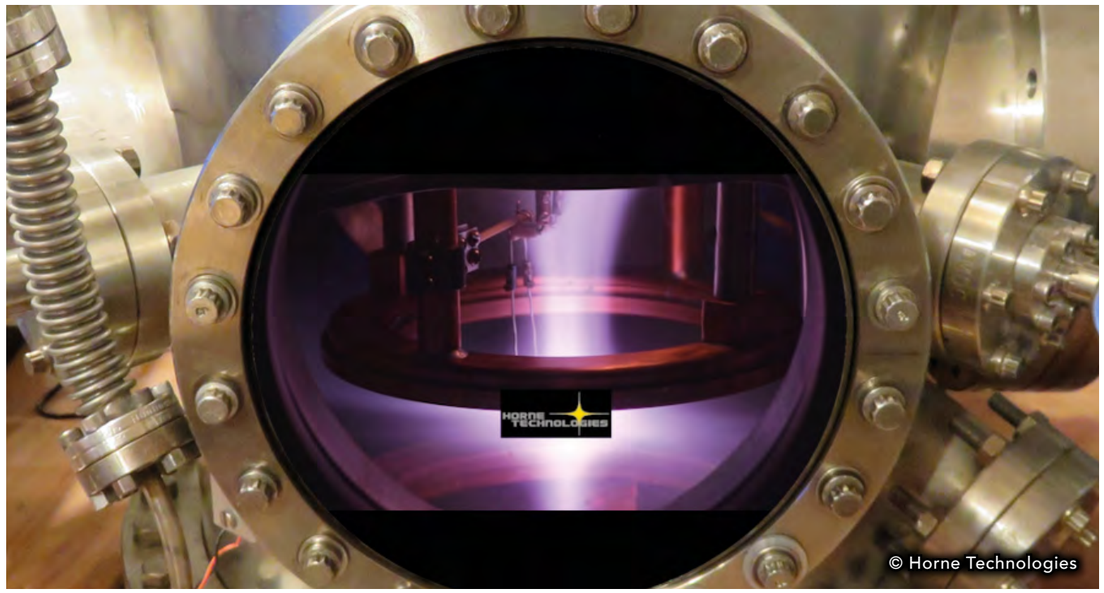
HORNE TECHNOLOGIES

Horne Technologies is a commercial fusion company targeting affordable advancement of fusion technology for near-term energy and neutron production. Horne Technologies' hybrid approach enables rapid low-cost iteration with fusion-capable, continuously operating devices.

Location	Longmont, Colorado, USA
Contact Details	hornetech@protonmail.com
Year founded	2008
Founder Names	Tanner Horne
Primary target markets	Electricity generation
Total declared funding to date	$1,650,000
Employees (incl. full time consultants)	3
General approach	Hybrid magnetic and electrostatic confinement
Specific approach	Spindle cusp, superconducting shielded-grid IEC
Fuel Source	DD, pB11
Milestones in past 12 months	Series A financing. Construction of Gen-II device. All systems operational for fusion temperatures. Continuing development of full power device utilizing 5T magnets and 100 keV temperature.
Pilot plant timescale	3-5 years
Anticipated MWe of first commercial operating facility	Less than 1 MWe



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HYPERJET FUSION CORPORATION

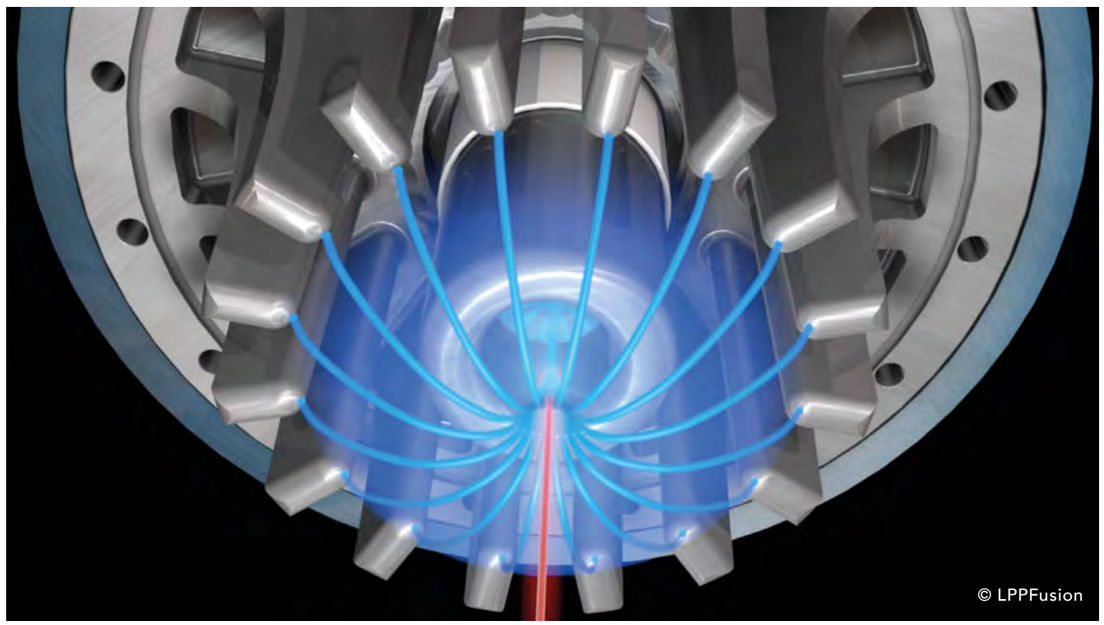
A company developing Plasma Jet driven Magneto Inertial Fusion

Location	Chantilly, Virginia USA
Contact Details	cfaranetta@hyperjetfusion.com
Year founded	2017
Founder Names	Doug Witherspoon
Primary target markets	Electricity generation
Total declared funding to date	$20,000,000
Employees (incl. full time consultants)	7
General approach	Magneto-Inertial Fusion
Specific approach	Plasma Jet Driven Magneto Inertial Fusion (PJMIF)
Fuel Source	DT
Planned energy capture approach	Lithium neutron 'blanket'
Milestones in past 12 months	Development and demonstration of magnetized fuel target plasma gun
Pilot plant timescale	TBD
Key collaborators/partners	Los Alamos National Laboratory
Spin outs/patents/innovations	High-temperature superconducting magnet, liquid metal application

LPPFUSION, INC.

Fusion R&D with a view to developing 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	$9,000,000
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
Milestones in past 12 months	World record for fusion plasma purity. Installed new switches.
Pilot plant timescale	2025
Anticipated MWe of first commercial operating facility	5 MWe



MAGNETO-INERTIAL FUSION TECHNOLOGY 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 compact, low cost and scalable reactor, which it 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 Rahman, Jerry Simmons, Mohammad Arshad, Norman Rostoker
Primary target markets	Electricity generation, Hydrogen/clean fuels, Industrial heat
Total declared funding to date	$9,000,000
Employees (incl. full time consultants)	9
General approach	Magneto-Inertial
Specific approach	Stabilized Z-pinch
Fuel Source	DT
Planned energy capture approach	Lithium neutron ‘blanket’
Milestones in past 12 months	Tested the idea on Linear Transformer Driver (LTD) and produced more than 10^8 fusion neutrons for 0.5 MA machine. Tested the idea on different codes like Hydra and Flash.
Pilot plant timescale	2030
Key collaborators/partners	University of California San Diego, University of Rochester, Lawrence Livermore National Lab,
Spinouts/patents/innovations	The same generator of much smaller size can be used to produce nuclear isotopes by neutron activation. These isotopes are used as nuclear medicines. Two patents are granted to date.
Recent published Papers	[1] Staged Z-pinch modeling of high and low atomic number liners compressing deuterium targets using parameters of the Z pulsed power facility, Physics of Plasma, 28, 112701(2021). [2] Study of stability in a liner-on-target gas puff Z-pinch as a function of pre-embedded axial magnetic field, Phys. Plasmas 27, 012702 (2020). [3] Ar and Kr on deuterium gas-puff staged Z-pinch implosions on a 1-MA driver: Experiment and simulation, Phys. Plasmas 26,052706(2019).

MARVEL FUSION

Marvel Fusion pursues a non-thermal direct drive inertial confinement approach with the goal of commercializing fusion energy using low-neutronic fuels. 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, Hydrogen/clean fuels, Industrial heat
Total declared funding to date	$65,000,000
Employees (incl. full time consultants)	40
General approach	Inertial confinement
Specific approach	Laser-driven inertial confinement
Fuel Source	pB11
Planned energy capture approach	Direct energy conversion
Milestones in past 12 months	-Conducted experiments in US & Japan showing scaling for shorter laser wavelength and for the first time shooting experiments with nanostructures - Set up industrial consortium with Siemens Energy, Thales, TRUMPF & others for power plant development - Manufactured first generation nanostructures - Raised EUR 35M Series A
Pilot plant timescale	2022-2025: upgrade existing laser systems and conduct experimental validation campaigns 2027 prototype constructed and operational
Anticipated MWe of first commercial operating facility	500-2,000 MWe
Key collaborators/partners	Siemens Energy, TRUMPF, Thales, Siegfried Glenzer, Florian Metzler, Ludwig Maximilian University of Munich
Recent published Papers	[1] A laser-driven mixed fuel nuclear fusion micro-reactor concept, arXiv:2202.03170, ***https://doi.org/10.48550/arXiv.2202.03170*** [2] Applicability of semiclassical methods for modeling laser-enhanced fusion rates in a realistic setting, Phys. Rev. C 105, 054001

N.T. TAO

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, Hydrogen/clean fuels
Total declared funding to date	$5,500,000
Employees (incl. full time consultants)	11
General approach	Magnetic confinement
Specific approach	Modified Stellarator
Fuel Source	DT
Planned energy capture approach	Lithium neutron 'blanket'
Milestones in past 12 months	Breakthrough in fast heating of high-density plasma
Pilot plant timescale	Before end of decade
Anticipated MWe of first commercial operating facility	10-20 MWe

NEARSTAR FUSION INC.

NearStar Fusion is developing a new pulsed approach to fusion called Hypervelocity Gradient Field Fusion (HGFF) that builds on successful methods of imploding metallic liners to create fusion energy and is also based in part on a NASA Innovative Advanced Concept study to produce fusion spacecraft propulsion.

Location	Chantilly, Virginia, USA
Contact Details	chris@nearstarfusion.com
Year founded	2021
Founder Names	F. Douglas Witherspoon, Chris Faranetta
Primary target markets	Electricity generation, industrial heat, fusion propulsion
Total declared funding to date	$200,000
Employees (incl. full time consultants)	7
General approach	Inertial Fusion Energy
Specific approach	Hypervelocity Gradient Field Fusion (HGFF)
Fuel Source	Potentially all fusion fuels starting with DT
Planned energy capture approach	Lithium neutron curtain for DT fuel
Milestones in past 12 months	Raising seed funding
Pilot plant timescale	2032
Anticipated MWe of first commercial operating facility	Approximately 50 MWe with the goal of modular scaling up to gigawatt class production.
Spin outs/patents/innovations	Fusion spacecraft propulsion, tunneling and shock physics research
Recent published Papers	Gradient Field Imploding Liner Fusion Propulsion System, NASA Innovative Advanced Concepts Phase, ***https://ntrs.nasa.gov/api/citations/20180006825/downloads/20180006825.pdf***

NK LABS, LLC

NK Labs, LLC, is an engineering company. We are developing muon-catalyzed fusion for production of clean energy and clean fuels. 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	sales@nklabs.com
Year founded	2008
Founder Names	Ara Knaian, Seth Newburg
Primary target markets	Electricity generation, Medical, Hydrogen/clean fuels, Industrial heat, Tritium production
Total declared funding to date	$1,830,000
Employees (incl. full time consultants)	20
General approach	Muon-catalyzed fusion
Specific approach	Muon-catalyzed fusion with high density fuel
Fuel Source	DT
Planned energy capture approach	Liquid metal with heat exchanger
Milestones in past 12 months	- Designed and built a detector and target assembly to measure the rate of muon-catalyzed fusion at high density - Conducted a beam period using the piE1 muon beam at the Paul Scherer Institute - Built a simulation and design optimization environment for muon catalyzed fusion based on GEANT4
Pilot plant timescale	**2032**: Construction of a plant showing commercial viability
Anticipated MWe of first commercial operating facility	100 MWe
Key collaborators/partners	ARPA-E, Fermilab, Paul Scherer Institute, University of Rochester Laboratory for Laser Energetics, York College, CERN
Recent published Papers	***https://www.sciencedirect.com/science/article/pii/S0010465522001023***

Princeton FUSION SYSTEMS

FIA MEMBER

PRINCETON FUSION SYSTEMS

Developing compact fusion reactors for modular and portable power systems.

Location	Plainsboro, New Jersey, USA
Contact Details	info@psatellite.com
Year founded	1992
Founder Names	Michael Paluszek, Marilyn Ham
Primary target markets	Electricity generation
Total declared funding to date	$3,000,000
Employees (incl. full time consultants)	6
General approach	Magnetic confinement
Specific approach	Field Reversed Configuration
Fuel Source	DHe3
Planned energy capture approach	Brayton cycle
Milestones in past 12 months	Increased magnetic fields in experiments, electron heating, improved density
Pilot plant timescale	2030
Anticipated MWe of first commercial operating facility	1 MWe
Key collaborators/partners	PPPL, GE Corporate Research, University of Rochester, Princeton University, NREL, Qorvo
Spin outs/patents/innovations	Power electronics for RF heating and high current pulse generation. New fusion energy toolbox for MATLAB.
Recent published Papers	[1] Lunar Cargo Tug Using Direct Fusion Drive, AIAA SciTech Forum, 19–21 January 2021, DOI: 10.2514/6.2021-0147 [2] The effect of rigid electron rotation on the Grad-Shafranov equilibria of a class of FRC devices ***https://iopscience.iop.org article/10.1088/1741-4326/ac0f96***

PRINCETON STELLARATORS

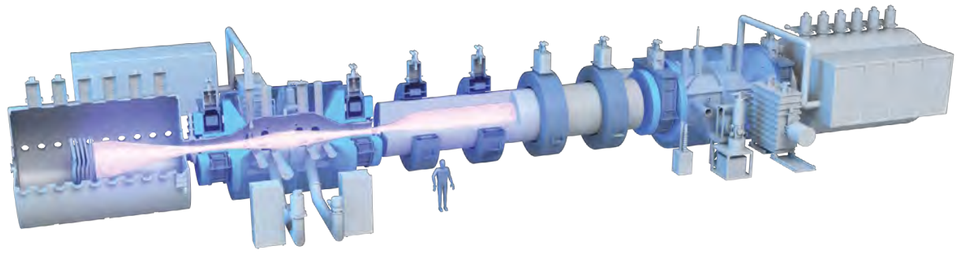
Princeton Stellarators is leveraging recent breakthroughs and IP that revolutionize stellarator technology. The company's fusion systems will create a limitless source of zero emission energy for a sustainable future of humanity.

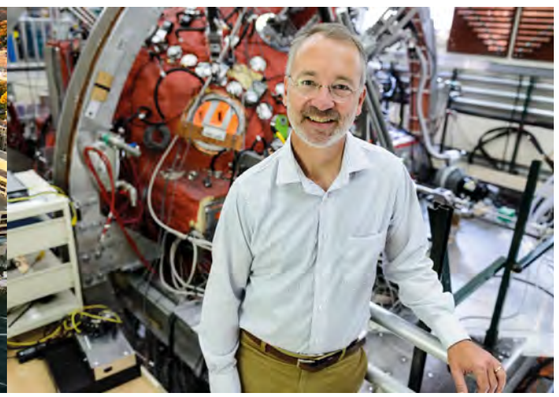
Location	Princeton, New Jersey, USA New York, USA
Contact Details	Info@PrincetonStellarators.energy
Year founded	2022
Founder Names	David Gates, Brian Berzin, Matt Miller
Primary target markets	Electricity generation, Medical, Tritium production
Total declared funding to date	Not disclosed
Employees (incl. full time consultants)	10
General approach	Magnetic confinement
Specific approach	Stellarator
Fuel Source	DT
Planned energy capture approach	Lithium neutron 'blanket'
Milestones in past 12 months	Company founded and initial funding. Prototyped magnet technology.
Pilot plant timescale	Q>1 prototype stellarator system before 2030.
Anticipated MWe of first commercial operating facility	>250MWe
Key collaborators/partners	Princeton University.

REALTA FUSION

Realta Fusion is an early-stage spin-out from the University of Wisconsin-Madison developing a modular fusion reactor. The compact, high magnetic field, tandem mirror reactor offers significant advantages in terms of reliability, maintenance, and operability. Realta is targeting initial uses in process heat.

Location	Madison, Wisconsin, USA
Contact Details	info@realtafusion.com
Year founded	2022
Founder Names	Cary Forest, Kieran Furlong, Jay Anderson, Oliver Schmitz, Ben Lindley
Primary target markets	Industrial heat
Total declared funding to date	Not disclosed
General approach	Magnetic confinement
Specific approach	Magnetic mirror
Fuel Source	DT
Planned energy capture approach	Lithium neutron 'blanket'
Key collaborators/partners	ARPA-E





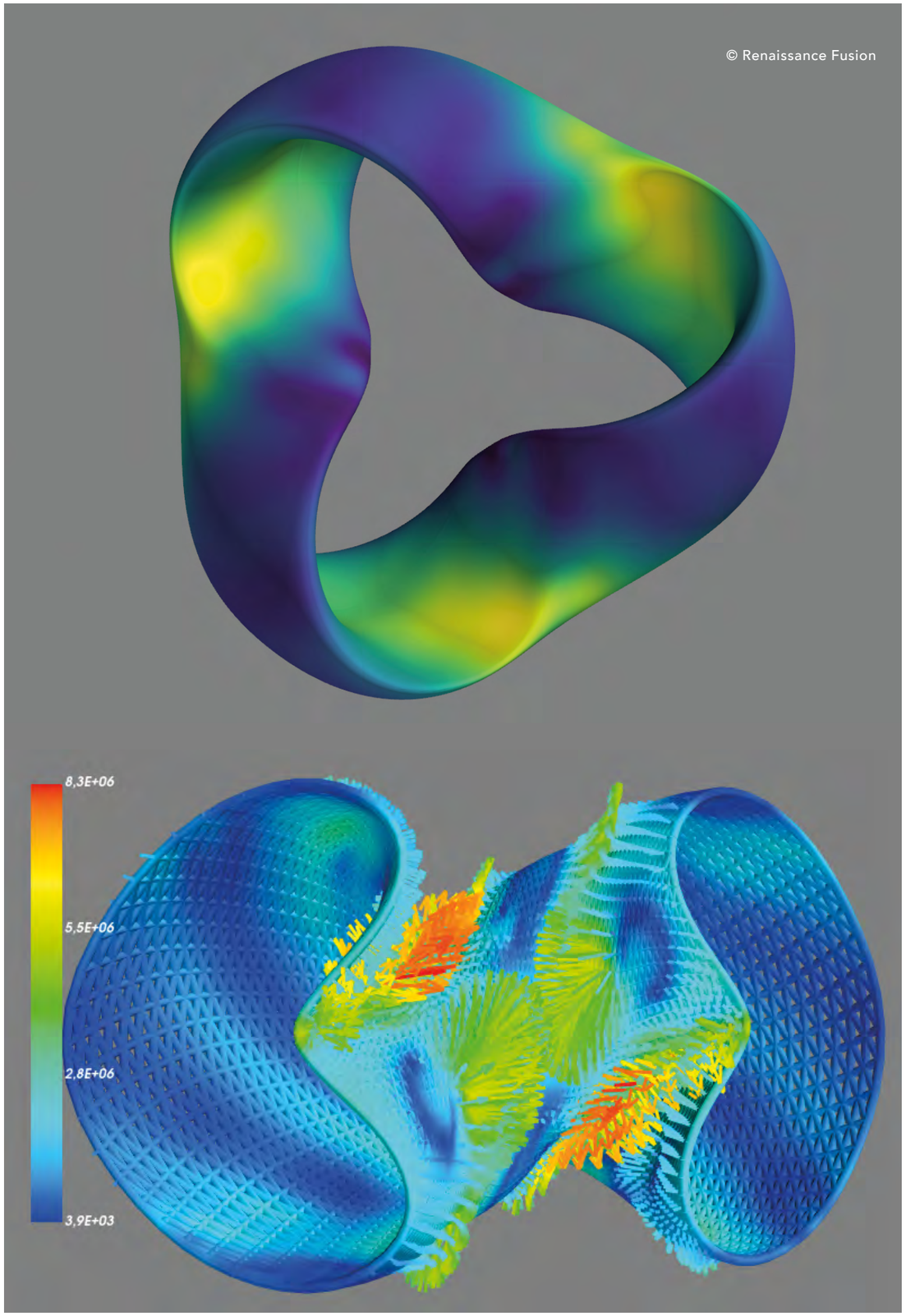
RENAISSANCE FUSION

FIA MEMBER

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
Contact Details	contact@renfusion.eu
Year founded	2020
Founder Names	Francesco Volpe, Martin Kupp
Primary target markets	Electricity generation, Medical
Total declared funding to date	$16,500,000
Employees (incl. full time consultants)	14
General approach	Magnetic confinement
Specific approach	Stellarator
Fuel Source	DT
Planned energy capture approach	Liquid metal with heat exchanger
Milestones in past 12 months	- Finalized pre-seed funding and laid ground for seed (multi-M€) round - Consolidated organization to reach 14 employees - Filed 10 patents - Moved into a 900 m² office+lab space - Performed system analysis of stellarator power-plant design point - Identified optimal plasma equilibrium and stellarator coil geometry - Modelled innovative HTS manufacturing procedure - Analyzed free-surface, full-coverage liquid metal flow experiment extrapolating to reactor scale
Pilot plant timescale	2027: small-scale net-heat demonstrator (Q>1) 2032: full-size net-electricity reactor connected to the grid
Anticipated MWe of first commercial operating facility	1000 MWe
Key collaborators/partners	BPI France, CEA, INRIA, Lorraine University, Strasbourg University, Sorbonne University (France), Tuscia University (Italy), Instituto Superior Técnico Lisboa (Portugal) AMPeers LLC, PPPL, University of Houston, Savannah River National Laboratory, Brookhaven National Laboratory (USA)
Spin outs/patents/innovations	Medical imaging magnets, magnetic energy storage



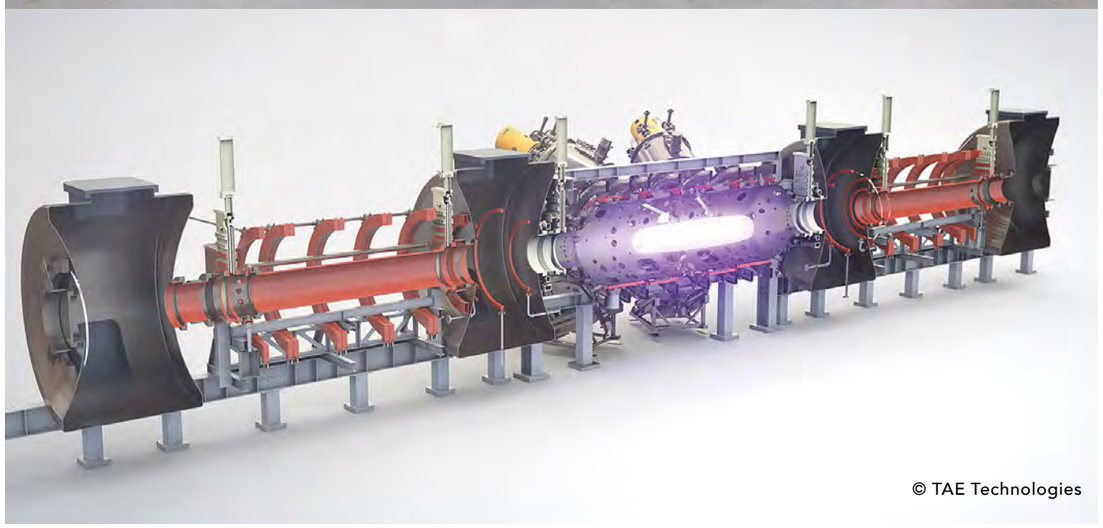
FIA MEMBER

tae TECHNOLOGIES

TAE TECHNOLOGIES

TAE Technologies (founded as Tri Alpha Energy) is forging the path to cost-effective, commercial fusion energy. Through its unique approach to fusion, TAE has developed spinoff applications in energy storage, electric mobility, life sciences, and more to create a complete clean energy ecosystem.

Location	California, USA
Contact Details	Media: ***press@tae.com*** Public Policy: ***pga@tae.com***
Year founded	1998
Founder Names	Numerous founders
Primary target markets	Electricity generation
Total declared funding to date	$1,000,000,000+ ($1bn)
Employees (incl. full time consultants)	~400
General approach	Magnetic confinement
Specific approach	Field Reversed Configuration
Fuel Source	p-B11; TAE configuration can accommodate all available fusion fuel cycles
Planned energy capture approach	Heat capture and conventional thermal cycle and / or future direct energy conversion
Milestones in past 12 months	75M+ degrees Celsius on Norman platform, 2022
Construction Status	Presently operating fifth-generation National Lab-scale machine, Norman; siting / construction underway for sixth-generation net energy machine, Copernicus.
Pilot plant timescale	2025: Copernicus will prove the viability of net energy demonstration. 2030s: Commercialization of Da Vinci device, the world's first prototype p-B11 / hydrogen-boron fusion power plant. For complete device timeline, see TAE.com/history
Anticipated MWe of first commercial operating facility	350-500 MWe
Key collaborators/partners	Google, U.S. National Laboratories, Japan's National Institute for Fusion Science. For complete list, see TAE.com/collaborators
Spin outs/patents/innovations	TAE Life Sciences - targeted cancer therapy; TAE Power Management - energy storage, electric mobility, off-grid/micro-grid, fast charging, and more. Over 1100 granted patents to date.
Recent published Papers	For complete list, see TAE.com/research-library



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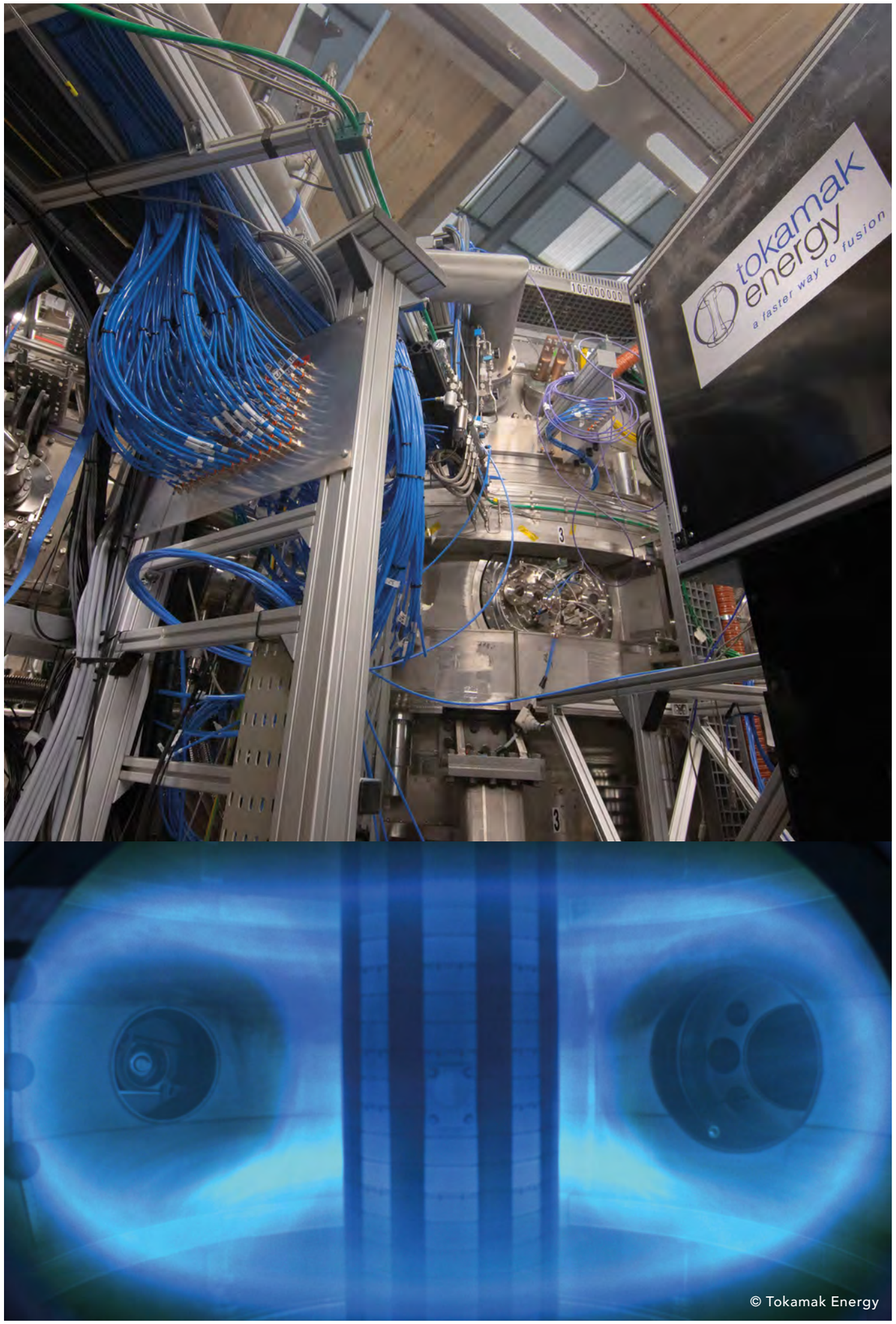
FIA MEMBER

TOKAMAK ENERGY

Tokamak Energy Ltd is pioneering commercial fusion energy based on compact spherical tokamaks with high temperature superconductor ("HTS") magnets. The company operates the ST40 spherical tokamak which has achieved 100 million degree plasma temperature and has demonstrated a 26T compact HTS magnet, tested at CERN.

Location	Oxford, UK
Contact Details	info@tokamakenergy.co.uk
Year founded	2009
Founder Names	David Kingham, Mikhail Gryaznevich, Alan Sykes
Primary target markets	Electricity generation
Total declared funding to date	$250,000,000
Employees (incl. full time consultants)	190
General approach	Magnetic confinement
Specific approach	Spherical tokamak
Fuel Source	DT
Planned energy capture approach	Lithium neutron 'blanket'
Milestones in past 12 months	100 million degree plasma ion temperature in ST40 prototype.
Pilot plant timescale	Early 2030s with a major device combining HTS magnets with the spherical tokamak by 2026
Anticipated MWe of first commercial operating facility	500MWe
Key collaborators/partners	Princeton, Oak Ridge and Los Alamos National Laboratories; Universities: Tokyo, Illinois, Oxford, Cambridge, Imperial, York, Lancaster
Spin outs/patents/innovations	Over 55 families of patent applications, many covering HTS magnets
Recent published Papers	Fusion performance of spherical and conventional tokamaks: implications for compact pilot plants and reactors: ***https://iopscience.iop.org/article/10.1088/1361-6587/abcdfc***



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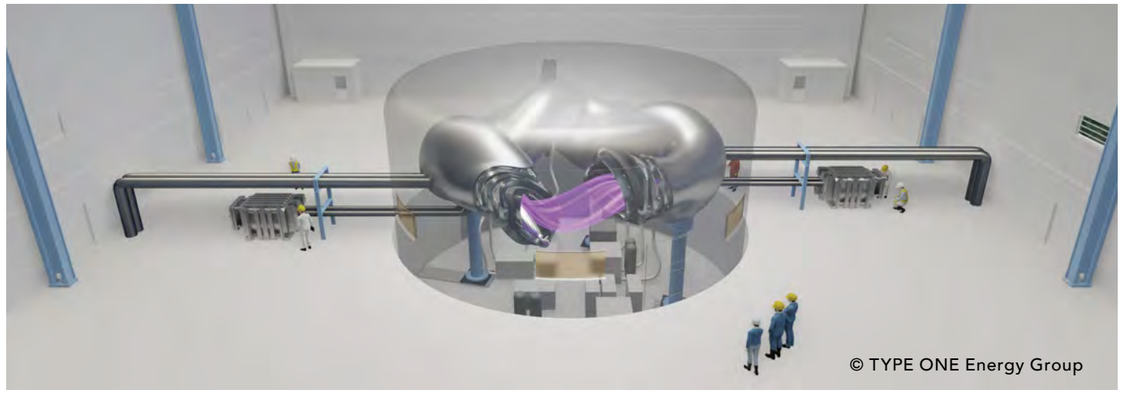
TYPE ONE ENERGY GROUP

Type One is commercializing the stellarator fusion concept, the ultimate clean power source, and making it affordable and available to all.

Location	Madison, Wisconsin, USA
Contact Details	projects@typeoneenergy.com
Year founded	2019
Founder Names	Randall Volberg, David Anderson, Chris Hegna, John Canik, Paul Harris
Primary target markets	Electricity generation, Hydrogen/clean fuels, Industrial heat
Total declared funding to date	$51,750,000
Employees (incl. full time consultants)	10
General approach	Magnetic confinement
Specific approach	Stellarator
Fuel Source	DT
Planned energy capture approach	Lithium neutron 'blanket'
Milestones in past 12 months	World's first HTS Stellarator Magnet
Pilot plant timescale	2035
Anticipated MWe of first commercial operating facility	500 MWe
Key collaborators/partners	University of Wisconsin- Madison, MIT/CFS, ORNL, IPP, SRNL
Spin outs/patents/innovations	Stellarator Optimization, Advanced Mfg for Fusion Reactors, HTS Magnets for Stellarators
Recent published Papers	Improving the stellarator through advances in plasma theory, Nuclear Fusion, Volume 62, Number 4



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XCIMER ENERGY INC.

Xcimer Energy is developing an inertial fusion energy system that will overcome long-standing obstacles to viable fusion power by integrating low-cost and high-energy excimer laser technology with the HYLIFE thick-liquid-wall chamber concept.

Location	Redwood City, California, USA
Contact Details	contact@xcimer.net
Year founded	2022
Primary target markets	Electricity generation
Total declared funding to date	Not disclosed
Employees (incl. full time consultants)	10
General approach	Inertial confinement
Specific approach	Laser-driven inertial confinement
Fuel Source	DT
Planned energy capture approach	FLiBe waterfall 'blanket'
Pilot plant timescale	Demonstration Laser Facility: 2025. MJ-scale Laser Facility: 2028. Pilot facility demonstrating commercial viability: 2032.
Anticipated MWe of first commercial operating facility	1 GWe

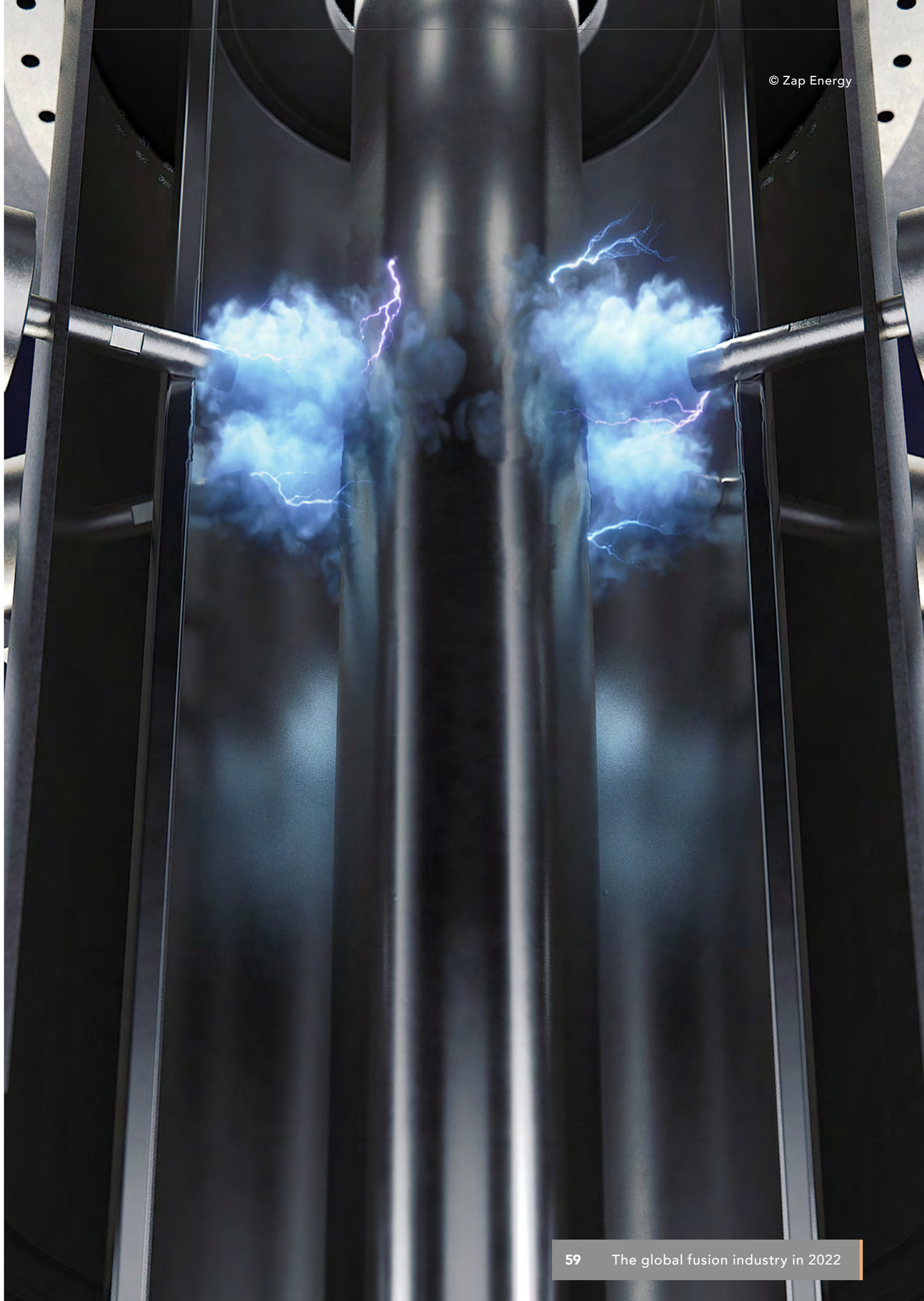
FIA MEMBER

ZAP ENERGY

ZAP ENERGY

Zap Energy is building a low-cost, compact, scalable fusion reactor with no magnets and the potential for a short path to commercially viable fusion energy.

Location	Seattle, Washington, USA
Contact Details	reachout@zap.energy
Year founded	2017
Founder Names	Benj Conway, Brian Nelson, Uri Shumlak
Primary target markets	Electricity generation
Total declared funding to date	$200,000,000
Employees (incl. full time consultants)	60
General approach	Magnetic confinement
Specific approach	Z-pinch
Fuel Source	DT
Planned energy capture approach	Liquid metal with heat exchanger
Milestones in past 12 months	- Added over 40 employees and tripled in size. - Increased power, performance and diagnostics of SFS Z pinches on FuZE prototype core, including operation at 500 kA of pinch current. - Built next generation FuZE-Q device, which began operations summer 2022.
Pilot plant timescale	Planning for a demonstration plant mid-2020's and a first-of-a-kind plant in 2030. Have begun initial discussions on first-of-a-kind pilot plant siting.
Anticipated MWe of first commercial operating facility	Each module is anticipated to be roughly 50 MWe, allowing scaling from small plants to GWe.
Key collaborators/partners	University of Washington; Lawrence Livermore National Lab; Los Alamos National Lab; Lawrence Berkeley National Lab; University of Nevada, Reno; DOE ARPA-E; University of California, San Diego; Woodruff Scientific
Recent published Papers	[1] "Thermonuclear neutron emission from a sheared-flow stabilized Z-pinch", Physics of Plasmas 28, 112509 (2021) ***https://doi.org/10.1063/5.0066257*** [2] "Development of five-moment two-fluid modeling for Z-pinch physics", Physics of Plasmas 28, 092512 (2021) ***https://doi.org/10.1063/5.0058420***



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