

# **Tri-Structural Isotropic (TRISO) Fuel Market Forecasts to 2032 – Global Analysis By Reactor Type (High-Temperature Gas-cooled Reactor (HTGR), Very High-Temperature Reactor (VHTR), Molten Salt Reactor (MSR), Gas-cooled Fast Reactor (GFR) and Other Reactor Types), Coating Material, Fuel Form, Deployment Phase, Application and By Geography**

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## **Abstracts**

According to Statistics MRC, the Global Tri-Structural Isotropic (TRISO) Fuel Market is accounted for \$414.16 million in 2025 and is expected to reach \$614.57 million by 2032 growing at a CAGR of 5.8% during the forecast period. A kind of nuclear fuel called Tri-Structural Isotropic (TRISO) fuel is intended for use in high-temperature gas-cooled reactors. It is made up of several layers of protective uranium, usually in the form of uranium dioxide or uranium oxycarbide. These combine to produce a small, robust particle and consist of silicon carbide, inner pyrolytic carbon, outer pyrolytic carbon, and a porous carbon buffer. This multilayer coating improves performance and safety in harsh environments by offering superior fission product containment. Because of its strong structure and resistance to melting, TRISO fuel is perfect for next-generation nuclear systems and sophisticated reactor designs.

Market Dynamics:

Driver:

Increased demand for advanced nuclear reactors

Strong, high-temperature resistant fuels like TRISO are necessary for these reactors to

operate safely and effectively. The special design of TRISO fuel provides excellent radioactive material containment, meeting the safety requirements of next-generation reactors. Investments in cutting-edge nuclear technologies by both public and private entities are increasing the need for TRISO fuel. Furthermore, the implementation of TRISO in sustainable power systems is facilitated by the global focus on clean energy solutions. Innovation and production capacity in the TRISO fuel sector are accelerated by this increasing traction.

#### Restraint:

##### High production cost and complex fabrication process

The production process is very costly because to the numerous layers of fabrication and specialised materials required. Furthermore, the intricate fabrication process restricts scalability by requiring sophisticated facilities and precise engineering. These difficulties deter investment and raise entry barriers for new producers. Consequently, TRISO fuel's economic potential is still limited. In the end, mass deployment in commercial nuclear reactors is delayed by the combination of complexity and cost.

#### Opportunity:

##### Government initiatives and R&D funding

Advanced nuclear fuel technologies are being heavily invested in by governments in major economies in an effort to lower carbon emissions and improve energy security. These investments frequently consist of agreements with private companies for the development of TRISO fuels and direct financing to national labs. Supportive laws and regulations also promote innovation and quicken the commercialisation process. Advanced testing, reactor demonstrations, and safety improvements are encouraged by public-private partnerships. TRISO fuel is therefore becoming more and more popular as a dependable and secure alternative for nuclear reactors of the next generation.

#### Threat:

##### Regulatory hurdles and public perception

Tight nuclear restrictions discourage new entrants by delaying licenses and raising development costs. Timelines for deployment are further slowed down by drawn-out licensing procedures. Social acceptance of nuclear energy is lowered by public

scepticism, which is frequently fuelled by safety worries and previous mishaps. Investment is hampered by misconceptions regarding the radiation dangers associated with modern fuels like TRISO. When combined, these obstacles limit market expansion and prevent TRISO fuel technology from being widely used.

### Covid-19 Impact

The COVID-19 pandemic had a modest but notable impact on the Tri-Structural Isotropic (TRISO) fuel market. Supply-chain delays—especially for graphite and silicon carbide coatings—slowed new fuel production. Budget re-allocations to urgent healthcare needs resulted in minor R&D postponements. Lower demand for nuclear research during lockdowns further decelerated project timelines. However, as global industries rebounded by 2021, investment in advanced reactor fuel, including TRISO, regained momentum—driving a recovery in production and renewed interest in its enhanced safety and performance benefits.

The silicon carbide (SiC) segment is expected to be the largest during the forecast period

The silicon carbide (SiC) segment is expected to account for the largest market share during the forecast period, due to its superior thermal conductivity and high-temperature tolerance, enhancing reactor safety and efficiency. SiC coatings provide an effective barrier against fission product release, ensuring containment under extreme nuclear conditions. Its chemical stability and corrosion resistance make SiC ideal for use in advanced reactors like high-temperature gas-cooled reactors (HTGRs). Growing demand for accident-tolerant fuels boosts the adoption of SiC-based TRISO particles in next-generation nuclear technologies. Additionally, advancements in SiC manufacturing processes are reducing costs and expanding commercial feasibility.

The electric utility sector segment is expected to have the highest CAGR during the forecast period

Over the forecast period, the electric utility sector segment is predicted to witness the highest growth rate, due to its growing interest in advanced nuclear technologies for clean energy generation. With increasing pressure to decarbonize and replace aging fossil-fuel plants, utilities are exploring TRISO fuel's safety and high-temperature tolerance for next-generation reactors. Small modular reactors (SMRs) using TRISO are especially appealing for distributed energy generation in remote or grid-stressed areas. Furthermore, TRISO's resistance to meltdown enhances grid reliability and energy

security, attracting investment. As utilities expand nuclear portfolios, demand for TRISO fuel is expected to accelerate steadily.

Region with largest share:

During the forecast period, the Asia Pacific region is expected to hold the largest market share due to increasing nuclear energy adoption in countries like China, South Korea, and Japan. China, in particular, has made significant progress in developing High-Temperature Gas-cooled Reactor (HTGR) technology, with TRISO fuel at its core. The region's focus on energy diversification, along with growing investments in next-generation reactors, is fueling demand. Strong governmental support and collaborative international research programs further accelerate innovation and commercialization of TRISO fuel in this high-growth market.

Region with highest CAGR:

Over the forecast period, the North America region is anticipated to exhibit the highest CAGR by renewed interest in advanced nuclear reactors and government initiatives promoting clean energy. The U.S. Department of Energy has been a key supporter, funding TRISO development projects and collaborating with private players like X-energy and BWXT. The market is further supported by national energy security goals and the need to decarbonize industrial sectors. With rising demand for high-temperature gas-cooled reactors, TRISO fuel is poised to play a vital role in the regional energy mix.

Key players in the market

Some of the key players profiled in the Tri-Structural Isotropic (TRISO) Fuel Market include X-energy, Kairos Power, TerraPower, TRISO-X, Westinghouse Electric Company, USNC (Ultra Safe Nuclear Corporation), Centrus Energy, Nukem Technologies, BWXT, Radiant Industries, New Millennium Nuclear Technologies International Inc. (NMNTI), Clean Energy Solar, Recycled Energy Development, LLC (RED), Gevo, Inc., Innospec Inc., Infineum International Limited, Chevron Oronite Company LLC and Afton Chemical Corporation.

Key Developments:

In December 2024, Westinghouse signed a contract with Kozloduy Nuclear Power Plant to conduct safety analysis for licensing a new nuclear fuel assembly design for Unit 6. This agreement diversifies Bulgaria's nuclear fuel supply and supports energy security

goals.

In July 2024, Kairos contracted Barnard Construction to begin excavation and site work for Hermes in Oak Ridge. Concurrently, cooperative agreements were established with Oak Ridge National Lab, Idaho National Lab, EPRI, Materion, Los Alamos, and TVA for fuel production, operations, licensing, and engineering support

In November 2023, Westinghouse completed the full acquisition of Tecnatom from Endesa, having previously held a 50% stake since 2021. This acquisition enhances Westinghouse's capabilities in nuclear refueling, maintenance, inspection services, engineering, training, and digital services, strengthening its position in the nuclear industry.

Reactor Types Covered:

High-Temperature Gas-cooled Reactor (HTGR)

Very High-Temperature Reactor (VHTR)

Molten Salt Reactor (MSR)

Gas-cooled Fast Reactor (GFR)

Other Reactor Types

Coating Materials Covered:

Pyrolytic Carbon (PyC)

Silicon Carbide (SiC)

Outer Pyrolytic Carbon

Other Coating Materials

Fuel Forms Covered:

Fuel Compacts

Pebble Fuel

Prismatic Fuel Blocks

Other Fuel Forms

Deployment Phases Covered:

Development Phase Reactors

Operational Reactors

Prototype Reactors

Other Deployment Phases

Applications Covered:

Electric Utility Sector

Space Propulsion

Research Institutions

Specialized Industrial Reactors

Other Applications

Regions Covered:

North America

US

Canada

Mexico

Europe

Germany

UK

Italy

France

Spain

Rest of Europe

Asia Pacific

Japan

China

India

Australia

New Zealand

South Korea

Rest of Asia Pacific

South America

Argentina

Brazil

Chile

Rest of South America

Middle East & Africa

Saudi Arabia

UAE

Qatar

South Africa

Rest of Middle East & Africa

What our report offers:

- Market share assessments for the regional and country-level segments
- Strategic recommendations for the new entrants
- Covers Market data for the years 2024, 2025, 2026, 2028, and 2032
- Market Trends (Drivers, Constraints, Opportunities, Threats, Challenges, Investment Opportunities, and recommendations)
- Strategic recommendations in key business segments based on the market estimations
- Competitive landscaping mapping the key common trends
- Company profiling with detailed strategies, financials, and recent developments
- Supply chain trends mapping the latest technological advancements

Free Customization Offerings:

All the customers of this report will be entitled to receive one of the following free customization options:

Company Profiling

Comprehensive profiling of additional market players (up to 3)

SWOT Analysis of key players (up to 3)

Regional Segmentation

Market estimations, Forecasts and CAGR of any prominent country as per the client's interest (Note: Depends on feasibility check)

Competitive Benchmarking

Benchmarking of key players based on product portfolio, geographical presence, and strategic alliances

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