

# **United States Space Fuel Market Assessment, By Propellant Type [Solid Chemical Propellants, Liquid Chemical Propellants, Hybrid Propellants], By Component [Combustion Chamber, Nozzle, Heat Exchanger, Flow Control Devices, Others], By Vehicle Type [Satellite Launch Vehicle, Human Launch Vehicles, Reusable Launch Vehicle, Others], By Region, Opportunities and Forecast, 2016-2030F**

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## **Abstracts**

United States space fuel market size was valued at USD 7.1 billion in 2022, which is expected to reach USD 22 billion in 2030, with a CAGR of 15.2% for the forecast period between 2023 and 2030. America's journey of space discovery is the continuous evolution of advanced technologies by space agencies that have imperatively developed effective space fuel. Extensive applications of space fuel can be profoundly explored in space applications like space tourism, rocket boosters, launch vehicles, etc. Various space program missions like suborbital satellites for advanced communication system, launched vehicles to unveil scientific patterns on revolving planets and reusable launched space modules for space tourism have encouraged scientists to develop effective space fuel for specific space programs. Advanced propulsion system technology, which works on the effective fuel consumption strategy has substantially created the importance of space fuel in space exploration.

Liquid hydrogen is a cryogenic compound which is considered a lightweight and incredibly powerful rocket propellant and is prominently a signature fuel of the United States space program. The United States contribution to major space programs is always admirable due to their efforts to build International Space Stations and develop

advanced system. Rocket fuel and propellants are extensively used in the space programs to carry sustainable rockets, either into the earth's orbit or beyond it. The commissioning of NASA's Apollo space program has fueled various spacecrafts by incorporating liquid hydrogen and oxygen as space fuel and is progressively accounting for more important space missions which are to be launched by NASA.

### Space Fuel Development in Satellite Applications

The growing demand to put more advanced satellites into orbit has tremendously increased as all technological practices depend on such rolling satellites. The United States government has released data that states that by 2022 around 5,500 active satellites are revolving in orbit and by 2030 another 58,000 are projected to be launched by different countries. The launching coordinates of the satellite from the earth's surface beyond the atmosphere varies from 80 miles to 22,000 miles. The Falcon 9 rocket developed by SpaceX can utilize around 902,793 lbs fuel. NASA's Marshall Space Flight Center has collaborated with Thiokol which progressively works on scrap Reusable Solid Rocket Motor (RSRM) propellant which gradually reduces pollutant waste while preserving the environmental impact.

The current propellant or fuel for launching of satellite is hydrazine-based fuel which is severely toxic and can be explosive and violent to nature. For different purposes like phone communications, high-tech network connectivity, and military operations, the satellites are launched into specific orbits like low-orbits, middle-orbits, and geostationary orbits where the requirement of rocket-based space fuel varies. The proliferation of space industry for launching rockets is creating massive opportunities for space fuel involving major space companies.

### Space Fuel as Rocket Propellants

Specific impulse measures the effectiveness of a space fuel which demonstrates the quantity of pounds (or Kgs) of thrust released by the consumption of one pound (or Kg) of fuel in one second. In general, specific impulse is defined as the length of time that a given quantity of fuel can produce a thrust equivalent to the propellant's initial weight. Propellants are generally classified into liquid, solid, and hybrid types. An excellent liquid propellant is one with a higher specific impulse or a massive speed of exhaust gas injection. A rocket with a higher specific impulse requires less amount of fuel compared to a rocket with lesser specific impulse. Liquid propellants are more elaborately categorized into petroleum fuels, cryogenic propellants, and hypergolic propellants.

Liquid oxygen in petroleum fuels and RP-1 are extensively used as the propellant in the first-stage boosters of Atlas and Delta II launch vehicles. Cryogenic propellants possess less temperatures and are difficult to store over longer time and require huge storage volume. Despite these demerits, liquid hydrogen or liquid oxygen is highly efficient and extensively used in the space shuttle launch. Liquid methane is a non-toxic cryogenic propellant which is futuristic development for Mars mission as a clean fuel. Hypergolic propellants include hydrazine, monomethyl hydrazine (MMH), and unsymmetrical dimethyl hydrazine (UDMH). NTO/MMH is progressively used in the space shuttle orbiter's orbital maneuvering system (OMS) and reaction control system (RCS). The space fuel as rocket propellants, has significant and extensive application in the launching of rockets and space vehicles and can have prominent potential for the United States to expand in the space horizon.

### Impact of COVID-19

The outbreak of COVID-19 created devastated impact on various industrial sectors across the United States, slowing down the country's progressive economy. The companies in the United States indulged in space exploration suffered the severe impact of COVID-19. The disruption in the supply chains, social-distancing, and unfavorable prevailing conditions led to shutdown of various space programs that were about to commence.

Based on published data in October 2020, COVID-19 has significantly impacted 56 NASA projects in 2020, where 30 projects were a major program based on technological research. In March 2020, under the Coronavirus Aid, Relief, and Economic Security (Cares) Act., NASA has received around USD 60 million intending to fund potential delay in the space programs.

### Impact of Russia-Ukraine War

The invasion of Russia on Ukraine has severely impacted the United States economy extending these implications to the space industry too. The annexation in 2022 has developed ramifications among the space companies where the stringent sanctions imposed by the United States on Russia has decreased their reliance on essential space equipment and technologies that earlier dealt with Russian space agencies. The space fuel market was affected and the unprecedented variation due to war led to less consumption of space fuel for different rocket boosters and launchers. The United States started building their own launch capabilities by replacing Russian engines and fuel exploration. The significant measures adopted by space agencies have again

created the United States market potential of space fuel generating multiple opportunities to expand space industry.

### Key Players Landscape and Outlook

Space companies across the United States are exploring various opportunities to build innovative space fuel technology. In May 2023, Lockheed Martin successfully built liquid hydrogen and liquid oxygen refueler for the sustainable human landing system. With more than 50 years of experience in space exploration, the company has progressively developed advanced fuel systems for different space projects. Similarly, Moog Inc. has administered cryogenic fuel with advanced engineering using liquid hydrogen and oxygen for launch vehicle propulsion system. With huge investment in innovative space exploration projects, companies are continuously trying to build more advanced space fuel for various space programs and launches.

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\*Companies mentioned above DO NOT hold any order as per market share and can be changed as per information available during research work

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