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Europe Space Fuel Market Assessment, By Propellant Type [Solid Chemical Propellants, Liquid Chemical Propellants (Petroleum, Cryogens, Hypergolic), Hybrid Propellants (Free-Radical Propellants, Liquid-Solid Propellants, Others)], By Component [Combustion Chamber, Nozzle, Heat Exchanger, Flow Control Devices, Others], By Vehicle Type [Satellite Launch Vehicle (Low-Orbit Satellites, Middle-Orbit Satellites, Geostationary Orbit Satellites), Human Launch Vehicles, Reusable Launch Vehicle, Others], By Region, Opportunities and Forecast, 2016-2030F

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Abstracts

Europe space fuel market size was valued at USD 5.4 billion in 2022, expected to reach USD 14.1 billion in 2030, with a CAGR of 12.7% for the forecast period between 2023 and 2030. Space companies are significantly engaged in environmentally friendly fuel components that can prominently reduce the carbon footprint. The exploration in space tourism has increased the demand for commercial suborbital flights where companies are looking for sustainable booster space fuels. Several toxic propellants such as hydrogen peroxide, nitrous oxide, and HTBP have frequently been used as space fuels. Still, their hazardous nature and difficult consumption has exacerbated their applications in the space industry.

Liquid hydrogen is a cryogenic compound that is considered as a lightweight and incredibly powerful rocket propellant and is a prominent signature fuel of the Europe space program. Europe contribution to major space programs has been admirable as

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their efforts to build international space stations and develop advanced communication systems. The proliferation of space industry has urged companies to develop sustainable and innovative space fuels that can progressively cut carbon emissions. Renewable biofuels are gaining prominent attention in discovering novel space fuels, generating advanced biofuels from wastes and sustainable vegetable oils, forestry waste, etc.

Greener Space Fuel in Space Applications

Hydrazine is a conventional used space fuel that comprises nitrogen and hydrogen and is considered very toxic and has remained under high concerns in the European Union's lists. Since early times, hydrazine has remained a significant fuel extensively used in satellite's onboard thrusters. Hydrazine, a highly toxic and corrosive compound, poses a tremendous threat to the environment as its small ppm composition can degrade plants and aquatic life completely. European Space Agency (ESA) and Swedish Space Corporation are progressively working to find alternative eco-friendly space fuel. They have developed a blend of ammonium dinitramide (ADN) with water, methanol, and ammonia, which performs around 30% better than toxic hydrazine. ADN fuel is convenient and safe to transport by aircraft and can easily be operated under normal dress outfits, replacing the costly protective suits.

The advantage of green hydrogen is progressively replacing the 'grey hydrogen' in various rocket boosters. French Space Agency, ESA, and space industries have collaborated to commence the green hydrogen project. Investment in green hydrogen development for space fuel will successfully cut costs, reduce cost caps of rockets with the rising fossil fuel prices, and preserve spaceport operations from enormous energy supply disruptions. With the significant development of greener fuel, the European market for space fuel has excellent opportunities to explode and drive multiple parameters towards space explorations.

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 propellant in one second. Propellants are generally classified into liquid, solid, and hybrid types. An excellent liquid propellant is one with a higher specific impulse or massive speed of exhaust gas injection. Liquid propellants are more elaborately categorized into petroleum fuels, cryogenic propellants, and hypergolic propellants.

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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 very difficult to store over longer time and require huge storage volume. Despite the demerits, liquid hydrogen or liquid oxygen comprises high efficiency and is extensively used in the launch of space shuttles. 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 orbital maneuvering system (OMS) and reaction control system (RCS) for the space shuttle orbiters. 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 Europe to expand the space horizon.

Hybrid Rocket Propellants as Space Fuel

A hybrid rocket propulsion system uses the inserted propellants in two different states of matter; one could be solid and the other could be either gas or liquid. Hybrid propellants can be stored easily and are non-toxic, which can effectively replace conventional space fuels. PLD Space, a Spanish company, is progressing toward developing two reusable micro-launchers, one for suborbital MIURA 1 and another for orbital MIURA 5, that will substantially provide commercial launches and expand space exploration worldwide. It belongs to the family of liquid-fueled engines called TERPEL, powered by kerosene and liquid oxygen (KeroLOX). The innovation in implementing hybrid space fuel has encouraged companies to derive from the space industry and led to the growth of the Europe space fuel market.

Impact of COVID-19

The outbreak of COVID-19 has led to an unprecedented impact on various industrial sectors across European countries which massively disrupts the progression of growth economically. The space industry was so vulnerable to the COVID-19 pandemic, halting the space projects for different European nations. Numerous SMEs indulging in space exploration encountered financial issues that led to project delays. The space project, ExoMars 2020, developed by ESA and Roscosmos, was officially postponed due to worsening in accomplishing necessary tests and arising difficulties in conducting relevant launches. The European Space Agency has prominently commenced several actions in response to the prevailing effect on space projects.

Impact of Russia-Ukraine War

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Russia which is a giant player in the space industry had led significant diplomatic ramifications due to the invasion on Ukraine. The harsh sanctions imposed by European Union (EU) has subsequently reduced their reliance on Russia to use their essential space equipment and technology. In response to EU sanctions, Russia withdrew its astronaut crew from the launch sites and ESA had cancelled its Soyuz launches. Despite disruptions in the space explorations, different space companies from European nations achieved promising collaborative development to build indigenous space fuel technology. In October 2022, Repsol and PLD Space collaborated to jointly develop renewable fuels for space vehicles. This prominent agreement among the companies has created immense potential for space fuel in the European market to expand the space horizon.

Key Players Landscape and Outlook

Space companies across Europe are prominently developing innovative space fuel technology that can enhance space exploration. Hydrogen peroxide is considered as a potential space fuel for the next generation in the evolution of space technology. Evonik is successfully producing hydrogen peroxide fuel which is delivering an alternate solution for compatible environment. The European Union is finding measures to permanently put a ban on carcinogenic space fuel such as hydrazine. Hydrogen peroxides, a high energy density compound can easily be handled and readily instigate the decomposition process at suitable temperature required for the propulsion technology. The company produces hydrogen peroxide for providing fueling systems to small rockets and microsatellites. Satellites while performing steering maneuvers in space can be accomplished effectively using hydrogen peroxide.

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